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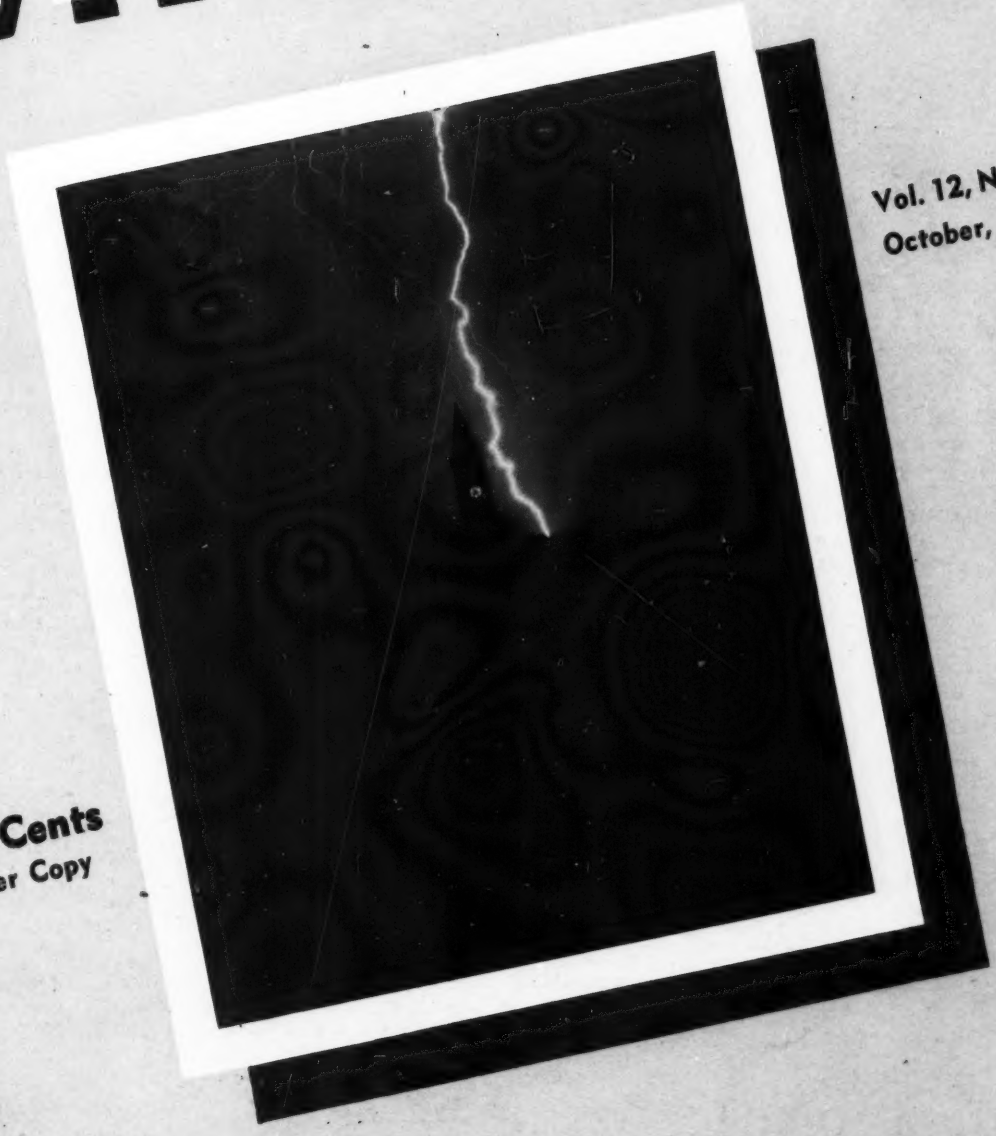

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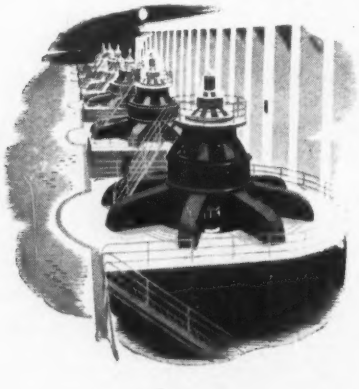

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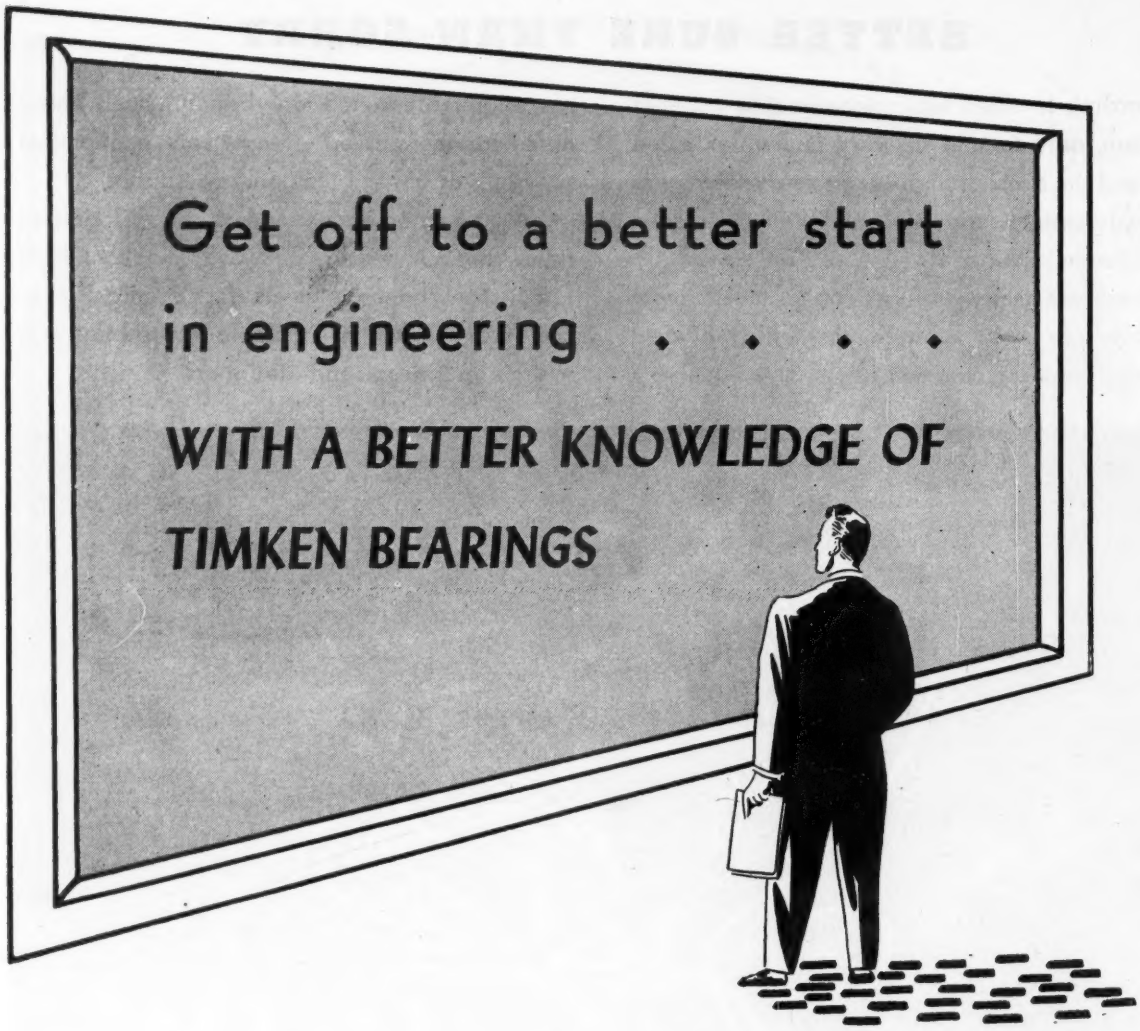

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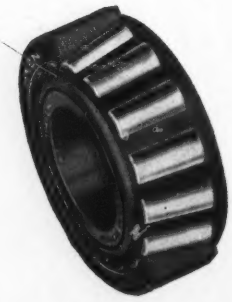

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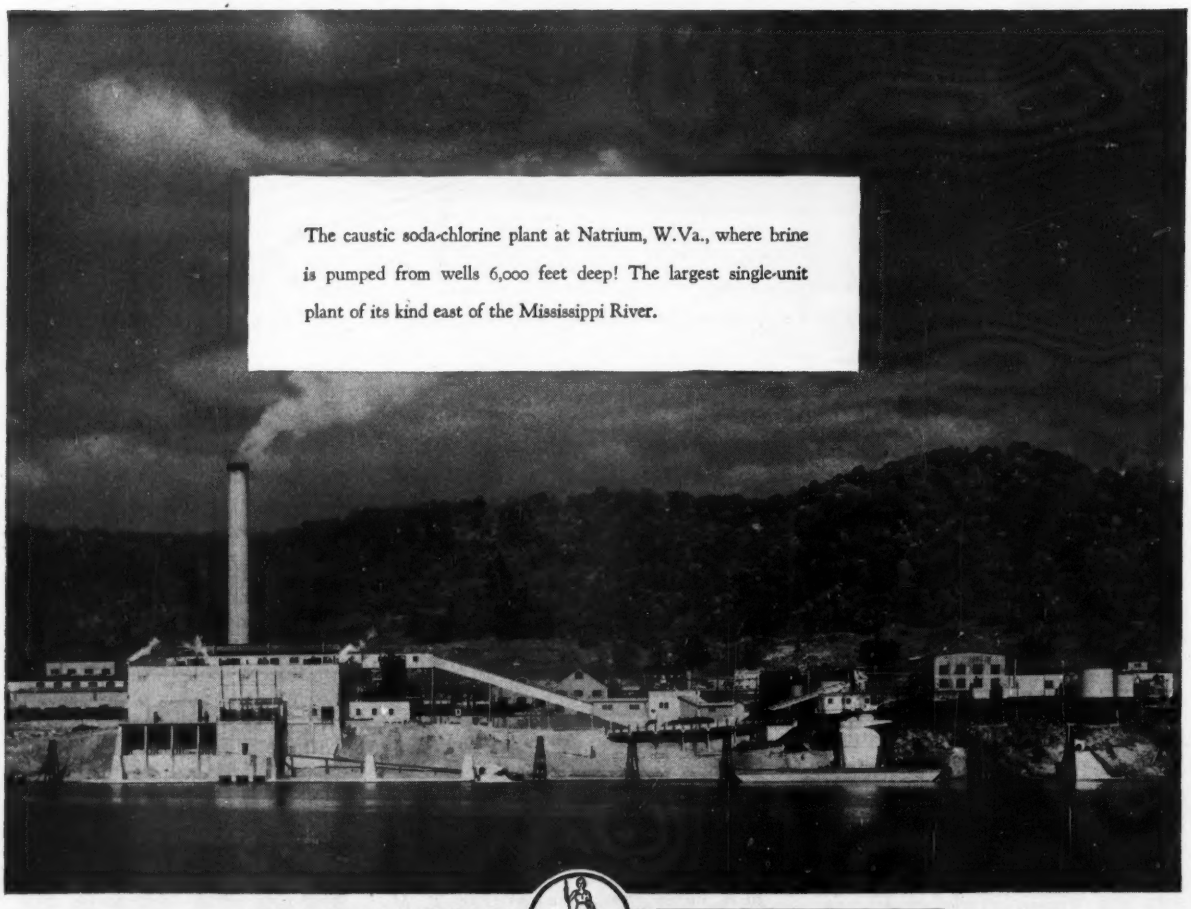
SODA BRIQUETTES (*iron desulphurizer*)
CALCENE T (*precipitated calcium carbonate*)
SILENE EF (*hydrated calcium silicate*)
PITTCHLOR (*calcium hypochlorite*)

The huge caustic soda-chlorine plant, shown below, was built and operated by Columbia for the Defense Plant Corporation. Columbia has now purchased it in order to bring this important source of chlorine and caustic soda into the cross-the-nation group of strategically located plants from which Columbia customers are served. Thus "Natrium" becomes a major factor in serving peacetime industry just as it was in producing gigantic quantities of chemicals for war.



The caustic soda-chlorine plant at Natrium, W.Va., where brine is pumped from wells 6,000 feet deep! The largest single-unit plant of its kind east of the Mississippi River.

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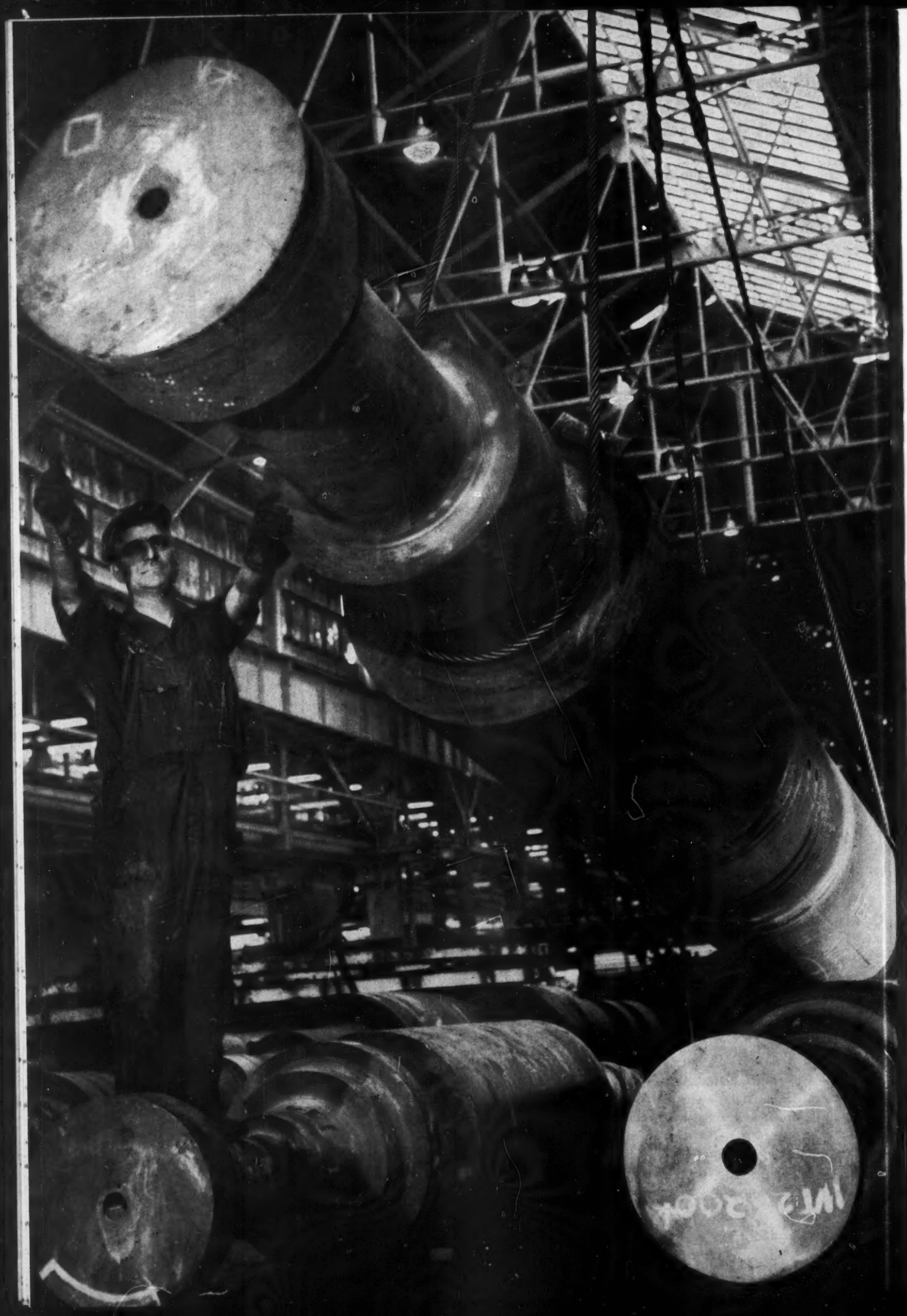


Electrical Engineering In A New Era

Engineering at Cornell (15)

By CHARLES R. BURROWS

Director of the School of Electrical Engineering

AFTER every war, the historian sets apart a period of time which he nobly inscribes with "The Reformation," "Reconstruction," "Restoration" or some other suitable synonym. We are now on the threshold of such a period after the most devastating war in the history of the world. It is noteworthy that the first signs of recovery from this devastation are the rejuvenation of our educational institutions. Before Poland houses or clothes her people, her scholars are trecking back into fragments of buildings having no heat or light, to study from partially destroyed texts and blackened libraries. Before China can feed her starving or set her political house in order, her Universities, so jealously guarded during the war—and carried on human backs from place to place when danger threatened—have already assembled some equipment for laboratories of research. In America we are more fortunate. Even though we have to contend with prefabricated Vetsburgs, chicken coop dormitories, war fatigued faculties and bulging enrollments, the American Universities stand on firm foundations ready to grasp the opportunity this transition period offers.

At Cornell, many adjustments must be made in our program to meet the new conditions war and a continued progress have imposed upon us. In no school are these adjustments more necessary than in the School of Electrical Engineering.

To make these new adjustments one must first recognize that we have entered on a new age. It will probably be characterized by the historian as the "Atomic Age," since that one discovery finished off the Japanese war in a startling way. The peacetime uses of atomic energy may perhaps be even more startling. A few of the new developments made during the war, namely: pulse modulation, the development of microwave techniques, microwave systems for multichannel telephone or television transmission from point to point, perfection of blind landing techniques, radio aids to navigation such as Loran and Radar—even these few make the stone man's world transforming discovery of metal a casual revelation.

Second, one must consider how the School of Electrical Engineering shall fit into this new age—and how it shall "run its race" to fulfill its purpose. It is evident the race can be run at neither a hare nor a tortoise pace.

The function of the School of Electrical Engineering is first, to make a student an educated man; second, to make him an Engineer; and third, to make him an Electrical Engineer. It is with this as a goal that the School is embarking on a five year curriculum this fall.

The engineer has done his job so well that technological developments far exceed social maturity. He has a responsibility for the effects of his achievements on the welfare of society, and the time has come for him to discharge this responsibility as a citizen. His education should prepare him to do just that. The five year curriculum has been designed with considerable emphasis on the humanities. Thirty-six hours of non-technical subjects are spread uniformly over the ten semesters. Of these, twenty-seven

THE AUTHOR

Professor Burrows received the B.S.E. (in E.E.) and E.E. degrees from the University of Michigan in 1924 and 1935, respectively. Columbia University granted him the degrees of A.M. and Ph.D. in 1927 and 1938.

For twenty-one years he was in the Radio Research department of the Bell Telephone Laboratories. In this capacity he contributed to the development of transoceanic radio telephony. Much of his research work has been on radio wave propagation, especially on the higher frequencies.

Dr. Burrows came to Cornell as Director of the School of Electrical Engineering in September 1945.

Chas. R. Burrows

Fig. 1. Laboratory setup for microwave propogation.

are specified, while nine are elective. The twenty-seven hours represent courses in Psychology, Economics, Modern Economic History, English, Public Speaking, Accounting and Composition of Technical Reports. These courses have recently been designed to fit the new curriculum and additional faculty obtained to teach them.

Nine hours are limited to cultural electives. Six more hours of electives may be chosen from any fields of interest.

Much is expected of an engineer. Early in his career he may be called on to carry out administrative duties, supervise men in his field, have charge of accounting schemes, give written reports—or convey by speech or written word a record of his achievements for cooperative efforts. Of these, the latter receives special emphasis. There is a continuous cry from industry that Engineers' oral and written discourse is still not acceptable. The order of the subjects in the new curriculum is, therefore, arranged to fill the need of the student to the best advantage. English, for example, is given during the first two terms, so he may profit therefrom in his other subjects throughout his college years. Some subjects, for example, Modern Economic History, are postponed until later when a more mature mind can acquire a fuller appreciation.

As in the past, the curriculum is based on the philosophy that in his formal study, the student should learn the fundamental laws of nature upon which the profession of engineering is built. The physics sequence extends throughout the freshman and sophomore years. These fundamental courses in physics are followed in the seventh term by an advanced course in which the student is brought abreast of the recent advances in physics which will form the foundation of engineering in the future. Likewise the mainstem mathematics courses have been extended throughout the first two years by the addition of a course in engineering mathematics in which the student is introduced to those processes and functions of higher mathematics which have now become necessary tools of the engineer. This sequence is followed by an advanced course in mathematics in the eighth term. The basic courses in general chemistry extending throughout the freshman year, are followed by two courses in engineering chemistry in the sophomore year, one embracing organic chemistry, and the other, physical chemistry. Hence, each of the sciences upon which engineering is based; physics, mathematics, and chemistry, are taken throughout the first two years.

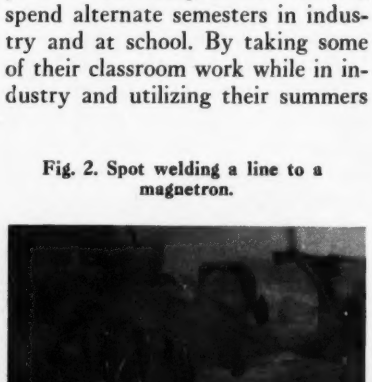
In the fourth term, the student begins electrical engineering subjects. These consist of more basic principles which are made a part of the thinking of the student by illus- the remainder of his college life, the student learns how the application of these principles has built up the technical achievements of the profession of electrical engineering.

The physical embodiment of these technical achievements are studied in the laboratory. Here the student bridges the gap from "textbook knowledge" to a genuine understanding of the subject. His work consists of determining the performance of various pieces of equipment and of explaining the characteristics which have been observed in a report written in clear concise language.

Cooperative Program

It has long been recognized that one of the most effective ways to prepare engineers for industry is by means of a cooperative program in which the student alternates his upperclass college work with periods in industry. This program is expensive and difficult to administer. Professor E. M. Strong is organizing this program for the school. Present plans anticipate that students qualified for this opportunity will be selected at the end of their first two years on the campus and will then spend alternate semesters in industry and at school. By taking some of their classroom work while in industry and utilizing their summers

Fig. 2. Spot welding a line to a magnetron.



in the alternate industry-campus program, it is expected that the students in the cooperative curriculum will graduate with their classmates who schedule the entire ten terms on the campus.

Research

"Research is not constructing and manipulating; it is not observing and accumulating data; it is not merely investigating or experimenting; it is not 'getting the facts'; although each of these activities may have an indispensable part to play in it. Research is the effort of the mind to comprehend relationships which no one has previously known; and, in its finest exemplifications, it is practical as well as theoretical; trending always toward worthwhile relationships; demanding common sense as well as uncommon ability. These are the three requirements in research: the spirit to adventure, the art to question, and the wisdom to accept and use."

While the primary function of the school is the teaching of undergraduate students, a necessary adjunct is research done by graduate students and members of the faculty. University research provides one of the means by which faculty members are kept in close contact with new developments and given an opportunity to be experts in a chosen field. The curricula and course content are maintained up to date. Illustrations used in the classroom to bring out fundamental principles are drawn from the latest developments. Students studying with a professor who is spending part of his time on university research may have the privilege of learning about a new development even before it is published to the engineering profession as a whole.

Besides the research that is being sponsored by the University, members of the faculty are working on research projects sponsored by the Office of Research and Inventions of the Navy, the Watson Laboratories of the Army Air Force, and Wright Field, also of the Army Air Force.

Facilities for research in the school have been expanded by remodeling the first floor of the engineering annex. Besides rooms for research, a graduate faculty shop allows the research worker to construct his own experimental equipment. Other research will be conducted in the basement of Franklin Hall, pending the construction of the new building.

During the war the school could not devote much time or energy to training graduate students because of the training programs for men in the Armed Forces. Now that it is possible to resume normal development of our program much more emphasis will be placed on the training of graduate students. One very interesting possible development in regard to advanced work of graduate level being studied at the present time with several of the electrical industries, is the possibility of carrying on graduate work by their employees.

Laboratories

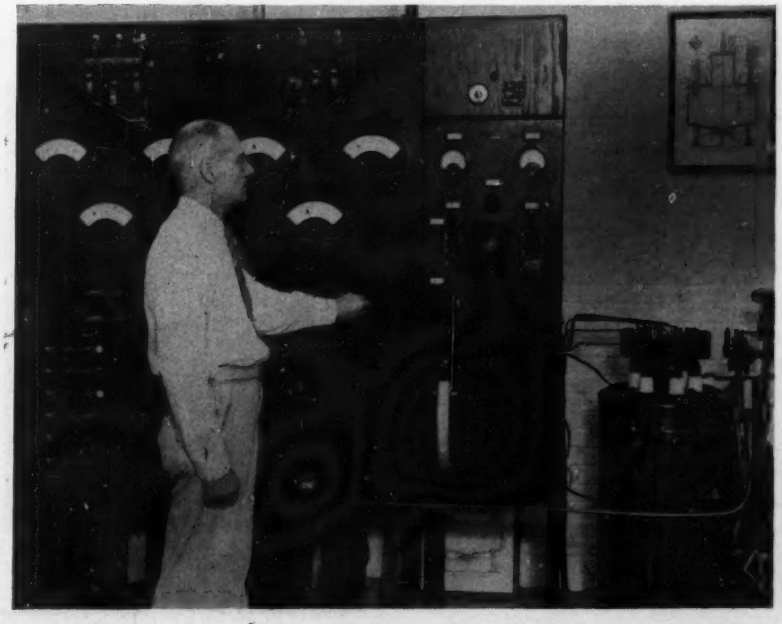
To implement the new undergraduate curriculum, inaugurate faculty research and expand the graduate work in the school, the laboratories are being modernized. The radio and communications laboratory has been in the process of modernization for several years. A corner of this laboratory, pictured in Figure 1, shows equipment set up for one of the experiments in course 4517. The bench, shown with experimental apparatus for the production and radiation of microwaves, is one of the many standard benches used in this laboratory. Each bench may have d-c or a-c power or any audio frequency voltage supplied to it from the distribution panel. A shelf above the bench provides space for plate and filament supplies and other auxiliary equipment. Circuit boards similar to the one stored on the bottom shelf made in standard sizes facilitate experiments on the various types of amplifiers and oscillators.

Many experimental vacuum tubes have been made by Professor W. C. Ballard and his students in the tube shop in the north-east corner of the basement of Franklin Hall. Figure 2 shows the transmission line being spot welded to a 10 cm. magnetron. Two of these tubes made in the laboratory are seen at the right of the picture. Plans call for enlarging these facilities so that a reasonably sized laboratory class can be accommodated this fall. Modern glass blowing equipment and other facilities for building the more complicated tubes will be installed.

Work has been under way during the last year, installing equipment in the industrial electronics laboratory and modifying it so as to be suitable for student instruction. A corner of this laboratory is shown in Figure 3. Professor B. K. Northrop is starting a mercury arc rectifier which he helped design. This rectifier is the first of its kind made by Allis Chalmers. The small

(*Continued on page 28*)

Fig. 3. Prof. Northrop with mercury arc recfier setup.



THE ENGINEER AND ORGANIZED LABOR

By JOHN E. FERRIS, Ph.C., L.L.B.

EDITOR'S NOTE

In a previous issue we printed an article on the engineer and organized labor. Because of the many letters we have received on this subject, and our own belief that this problem is one of the most pressing before the young engineer of today; we are publishing the accompanying article by Mr. Ferris which presents his opinion of the other side of the problem.

Mr. Ferris gives us something of the background of both the professional engineer and the labor movement; and then goes on to draw the conclusion that collective bargaining for engineers is not desirable. We sincerely hope that these articles can help to clarify this perplexing problem.

THE subject matter following will be divided into three general divisions. 1. The Professional Engineer. 2. Organized Labor, its character, methods and objectives. 3. Collective Bargaining and the Engineering Profession.

1. The Professional Engineer

The professional engineer is one, who by systematic study and education, has acquired an intellectual skill in the application of mathematics to construction, machine design, electrical applications, and the chemical and physical sciences. His abilities become manifest usually, by the trained knowledge and understanding of those sciences, when employed singly or in combination. He is one who has attained a true mental vision of the natural laws and processes of those sciences. It is the vocation of the professional engineer to practically apply his trained knowledge to materials, in order that a perfect machine; a safe and useful building, or a valuable service may result from his trained mental capabilities. His value to industry, construction, power or utility, exists, because he has become learned in the applications of technical laws, and vested with the ability to apply them accurately, for the highest welfare of mankind. The intellectual level of the modern professional engineer, is equal to the finished educated abilities, in law and medicine. The professional engineer rightfully belongs in the "learned profession" classification. Achievements infinitely greater than those gained by body labor, or hand skill, are required of the professional engineer. It is conceivable that an armless man, could become a very capable engineer.

Professional engineering is now legally recognized as a profession by the statutes of most states. Laws regulating and governing the practice of professional engineering, have become so well established, that professional engineering in states not having such laws, can only await similar enactments, by their respective states.

Section 101.31 of the Wisconsin statutes provide for the registration and licensing of Professional Engineers. The statutory definition of a Professional Engineer is given, as follows:—

"Any person practicing, or offering to practice the profession of professional engineering in this state, shall be required to submit evidence that he is qualified so to practice, and shall be registered, as hereinafter provided; and it shall be unlawful for any person to practice, or offer to practice the profession of architect and the profession of professional engineering in this State, or to use in any connection with his name, or otherwise assume, use or advertise any title or description, tending to convey the impression that he is an architect, or professional engineer, or to advertise to furnish architectural or professional engineering services, unless such person has been duly registered and exempted under the

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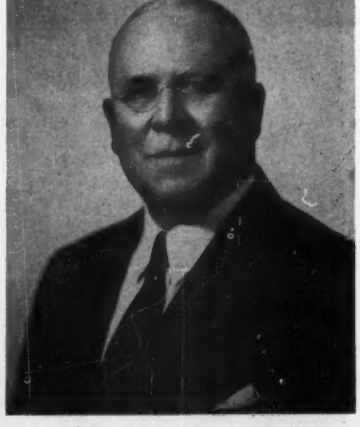


John E. Ferris

John E. Ferris entered the School of Civil Engineering, Cornell University in 1896, but withdrew because of the death of his uncle, George Ferris, the inventor of the Ferris Wheel. Further education was obtained at the U. Michigan where he graduated with the degree of Ph.C. In 1928 he received the degree of L.L.B. from the College of Law, Marquette University, and was then admitted to the Wisconsin and Milwaukee Bar. He is past Vice President of the Cornell University Alumni Association of Milwaukee, a member of the Cornell Society of Engineers and The Engineers Society of Milwaukee.

provisions of this Act."

"Professional Engineer means a person who, by reason of his knowledge of mathematics, the physical sciences and the principles of engineering, acquired by professional education and practical experience, is qualified to engage in engineering practice, as hereinbefore defined."

"The practice of professional engineering includes any professional service, requiring the application of engineering principles and data, wherein the public welfare, or the safe-guarding of life, health or property is concerned or involved, such as consultations, investigation, evaluation, planning, design or responsible supervision of construction, alteration or operation in connection with any public or private utilities, structures, projects ,industrial plants and buildings, machines, equipment, processes, work and structural members of other than industrial buildings."

The Wisconsin law provides for a Registration Board appointed by The Industrial Commission of Wisconsin, to be composed of nine members, to consist of the Dean of the College of Engineering of the University of Wisconsin, the State Architect, the State Engineer, three architects and three professional engineers, who shall have been engaged in engineering practice for ten years. This board constitutes a panel, to pass upon the applications of engineers for licenses to practice. Each applicant must submit a specific record of seven years or more of active practice in engineering work, of a character satisfactory to the Board, indicating that the applicant is competent to be placed in responsible charge of such work.

In lieu of the foregoing, the applicant must hold a diploma of graduation in engineering, or a satisfactory certificate in engineering from a school or college, approved by the Board, having a course of engineering of not less than four years, and a specific record of an additional three years of actual practice in engineering work, of a character satisfactory to the Board, and who is competent to be placed in responsible charge of such work. Graduation in engineering from a school of recognized standing, shall be considered as equivalent to four years of active practice. The completion of each year of work in such school, shall be considered equivalent to a half year of active practice. Graduation in a course, other than engineering, from a recognized college or university, shall be considered as equivalent to two years of active practice, provided that no applicant shall receive credit for more than four years of active practice, because of educational qualifications. The Board, in its discretion may require the applicant to pass an oral, or written examination, or both.

An employee of a person holding a certificate of registration, and any person who is exclusively a regular employee of a registered professional engineer, a private engineering company, or corporation, rendering engineering service, in connection with its operations, is exempt from the registration and license provisions, so long as that person is actually and exclusively employed by such licensee.

2. Organized Labor

Organized labor is an association of workers, who are dependent upon their physical labor, or the skilled manual usefullness of their hands for a livelihood. Organized labor is not concerned with the intellectual capabilities of its members. Its only concern is in the individual, who uses his physical strength to earn a living, which exerted strength is devoted to construction, mining, production, maintenence, and transportation in commerce and industry. A worker who possesses a university education, and who becomes a member of a labor union, is looked upon with suspicion and distrust. The educated status of the average labor union member, and even the officers thereof, seldom reaches a higher intellectual level than that of a high school graduate.

Organized labor depends upon the solidarity of mass human force, characterized by a consolidated power of purpose, directed toward the economic advancement, security of employment, and the uniform common interests of laboring people. Policies, national and local in scope, are formulated, usually, by union administrative officials, sitting in "starchamber" sessions, behind closed doors. The officials take "henchmen" into their confidence, who pass on the predetermined plans to the rank and file.

Due to the pressures of divergent complexes, the worker often becomes sullen, uncommunicative and stolid, when at work. At this juncture the labor union business agent appears. By the use of coarse linguistic toughness, the worker becomes impressed with the ability of the labor union, to relieve him of his distress, and the discomforts of his individual helplessness. Incitements are aroused within the mind of the worker, that his employer is his sugar-coated enemy, and that only by joining the union, can the designs of a scheming employer be restrained. As a surcease to one fear, he decides to attend the local union meeting. He is surprised at the small number of members present. He had been told that "the Union" has thousands of active members. Several hundred occupy the seats in the union hall. He observes that an organized clique is in control, and he listens to arguments, backed by threats of physical violence, when the spokesman for the local "gang" is opposed by anyone. The new union member goes home, "with his fist in his pocket," decides to pay his monthly dues, and join the absentee majority, henceforth. He has been convinced that the methods (and the technique) of organized labor, gain their objectives by mass, brute force, fair or unfair, by vast numbers combined for their own ends.

When the Wagner Labor Relations Act was enacted in 1935, labor became a legal entity, and its field of activity, so far as its relationships with the employer are concerned, became fixed. The Wagner Act, however, places practically all of its mandates for legal performance upon the employer, with very few questionable duties being imposed upon labor. It is a one-sided. one-way, unfair law, whereby the employer is "fenced in", restricted and restrained in his freedom of action, or discretionary powers. It guarantees to Labor the right to organize; to name representatives of its own choosing for the purposes of

(*Continued on page* 38)

JET AND ROCKET PROPULSION

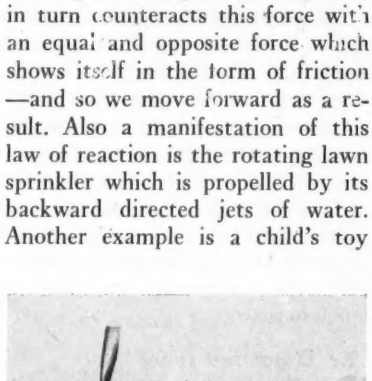
By DANIEL K. ROBERTS, ME '49

Cuts courtesy of Westinghouse

MAN'S search for the unseen wonders of nature have made the mythological seven-league boots seem comparable to a mere snail's pace when set side by side with the broad chasms which science has breached in recent years. Although day-dream fantasies of gigantic rocket ships and other Buck Rogers' innovations are not at present in the stage of reality, many of the astonishing new discoveries made public since the end of the war have shown us that many such dreams are being realized. Radar, jet and rocket propulsion, and atomic energy are constantly enlarging their grasp on the future of the world. Great changes have taken place in aircraft and more are to come, but the temptation to make statements regarding the future of aviation has a tendency to be misleading at times. Let us take a broad view of the picture so that by a personal interrogation of any further developments in the field of jet and rocket propulsion, we will have some means of understanding their rudimentary structure.

The few simple words of Sir Isaac Newton, "To every action there is an equal and opposite reaction; the mutual actions of any two bodies are always equal in intensity and opposite in direction", have been the key to a new world of scientific exploration. Supersonic speeds are within our grasp. The delivery of mail from city to city via rocket is practically at our doorstep. A journey to the moon in a ship propelled by a reaction motor has already been discussed by several scientists.

In every day life we apply this third of Sir Isaac Newton's laws of motion. When we walk we apply a force against the ground, the ground in turn counteracts this force with an equal and opposite force which shows itself in the form of friction —and so we move forward as a result. Also a manifestation of this law of reaction is the rotating lawn sprinkler which is propelled by its backward directed jets of water. Another example is a child's toy balloon which, when fully blown up and released with its orifice open spins crazily until it has exhausted its supply of air.

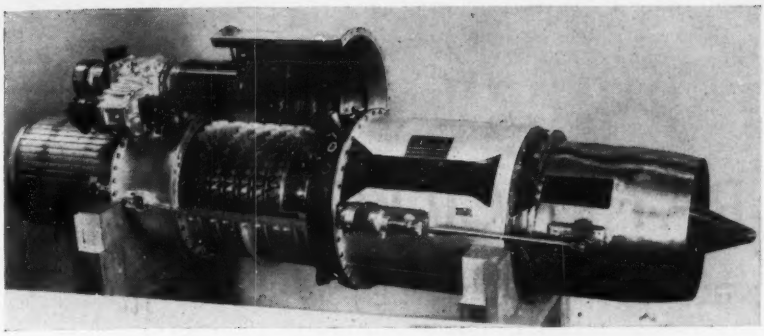


One of the first experimental installations of the axial flow gas turbine was in this Corsair fighter. The long slender "cigar-like" housing under the fuselage is a model 19A jet booster, the forerunner of the 19B. It was capable of 1375 hp at 375 mph.

In this third law of motion, the opposing terms are action and reaction. However, it is the reaction that is desired in producing flight. It is this application that will be discussed. At present there are two basic types of successful reaction machines. They are: (1) the rocket motors; and, (2) the airstream engines. Their basic relationship lies in Newton's third law which in application means that the propulsive thrust is proportional to the product of the mass of the material expelled from the engine in a given time and its increase in velocity with respect to the engine. This may be produced by either expelling rearward a large amount of material at low velocity in definite time, or by expelling a small amount of material at a high velocity in the same time. Contrary to the popular misconception, nothing is needed for the jet to push against. Actually any material outside the jet orifice gets in the way of the ejected material and thereby reduces its forward thrust. For this reason rockets produce their maximum thrust in a vacuum.

Theoretically, it does not matter what the ejected material is—solid, liquid, or gas. Practically, however, gaseous products of combustion are desirable. Their mass is comprised of the weight of oxygen, the fuel, and any inert gases, which by the nature of their production can be expelled at high velocity. The rocket differs from airstream engines in that it carries its own oxygen supply, either in liquid form or mixed chemically in solid form such as cordite or gunpowder. The liquid fuel type has several advantages over the solid fuel type, but it does have its own disadvantages. Namely, liquid oxygen boiling at -297°F is a most vicious substance which entails special handling. The extremely high temperatures of combustion have imposed the most rigorous of metallurgical problems on rocket experiments.

All propulsive devices can be considered to consist of a heat engine that converts fuel energy into mechanical energy, together with a device for converting this energy into a rearward jet by expansion in a nozzle. The oldest and best known



A photograph of the 19B with compressor housing removed.

motor operating on the jet propulsion principle is the solid fuel rocket motor. It is known to have been used in 1232 AD. A type of solid fuel rocket motor is the Fourth of July skyrocket. Its chassis consists of a paper cylinder with a cone shaped nose to decrease air resistance and a trailing stick to give it some stability and guidance in flight. In the forepart of the cylinder is the payload which is usually a charge of powder which burns colorfully when ejected from the rocket. The main body of the rocket surrounding the combustion chamber is the mass of solid fuel and the oxidizer. The efficiency of the jet is increased by a crudely shaped nozzle at the rear. The fuel when ignited burns away rapidly, the products of combustion being gases that are expelled through the downward projecting nozzle to produce the upward thrust; but once combustion is started control of the rocket is lost.

The liquid fuel rocket motor, the motor that powered the German V-2, uses any of the common petroleum products as fuel. Combustion with liquid fuel is subject to control, which is an advantage over the solid fuel type. The fuel and oxygen are brought together in a combustion chamber and provide high-velocity jets. Those vehicles intended for ascent beyond our atmosphere—barring the use of some new form of energy—will be liquid fuel rockets.

All the energy produced by a rocket motor is in the jet. At speeds between zero and its jet velocity the energy is divided between the rocket and its wake; the energy in the wake being proportional to the square of the wake velocity. Rocket motor jet velocities are high, being at least 300 feet per second (about 2000 mph). Consequently rocket motor propulsion efficiencies below 500 miles per hour are poor, showing that best use of the rocket is for high velocities.

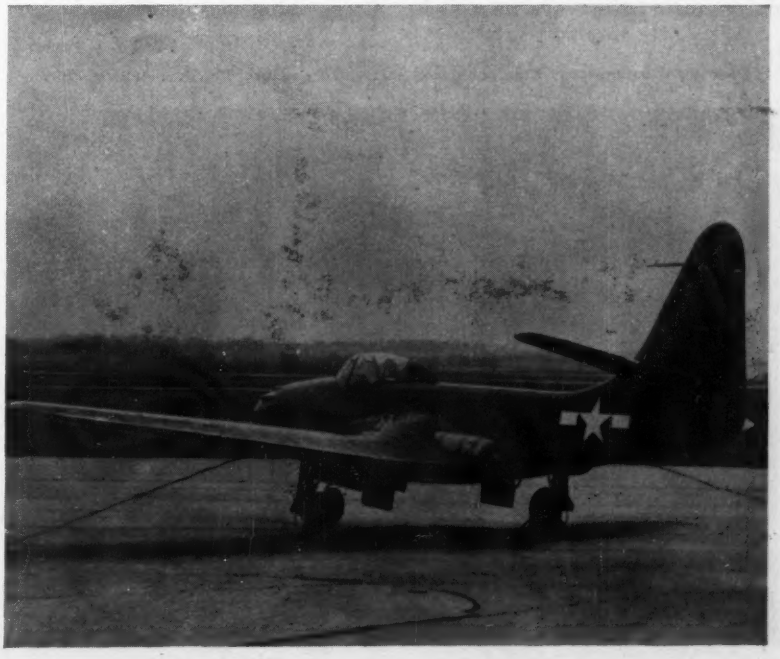
Because a given thrust can be provided either by handling a large mass at a low velocity or a smaller mass at a higher velocity, air stream engines do not depend on as high jet velocities as do rocket motors. To keep the jet velocities low, i.e. decrease the loss in the wake, large masses of air in excess of that required for combustion pass through the gas turbine jet. This provides the large mass at low velocity required for the given thrust.

Contrary to the rocket, which carries its own oxygen for combustion, the jet engine obtains its air from the outside. The general procedure of action in the jet engine is as follows: (1) Air is pumped in by a compressor; (2) the air is heated by burning liquid fuel in it; (3) A portion of the energy of the hot combustion products which have been expanded to several times their original volume, is used to drive a turbine, the sole purpose of which being to supply power to keep the compressor going; (4) The remaining horsepower is not delivered to a shaft, but appears in the form of a high velocity jet. It is the reaction of this jet that propels the aircraft and causes forward motion.

Due to the increase in temperature of the air from the time it enters the front of the engine until it rips from the tail pipe, its speed jumps from 300 miles per hour to 1200 miles per hour. Since air, like everything else expands as it heats, one cubic foot of heated air at 1500 degrees Fahrenheit attempts to occupy nearly four times the volume at the same pressure as it did when

(*Continued on page* 44)

Side view of the Navy FD-1 Phantom a twin engined jet craft capable of attaining speed of over 500 mph. Intended for carrier operation, it has a range of approximately 1000 miles. The plane utilizes two 1400 pound thrust axial flow gas turbines.



A Cornell First

CATHODE RAY OSCILLOGRAPH

By HANNIBAL C. FORD, M.E. (E.E.) '03

DEVELOPMENT in the field of electronics has been so extensive in the past few years, that it may be of interest to present to Cornellians a little early history of the cathode ray oscillograph—one of the earliest, if not the first, important development in this field.

The cathode ray tube for such use was first produced by Professor Braun in Germany about 1897. He found that a stream of electrons flowing from the cathode—that is the so-called cathode ray—could be deflected laterally by a magnetic field and, when projected on a fluorescent screen within the vacuum tube, the amount of deflection could be observed.

The cathode ray oscillograph was used to some extent for many years by physicists and electrical engineers to indicate wave form and other electrical phenomena, but has lately assumed much greater importance. Cathode tubes are now available in many forms and are extensively used in laboratories and industrial plants for many different purposes. With the advent of television, this tube provides the only practical means for displaying an image of the built-up picture.

Probably few of the many who now use this instrument realize that it was first developed for practical use in America about the year 1901 at Cornell University by the late Harris J. Ryan, then Professor of Electrical Engineering.

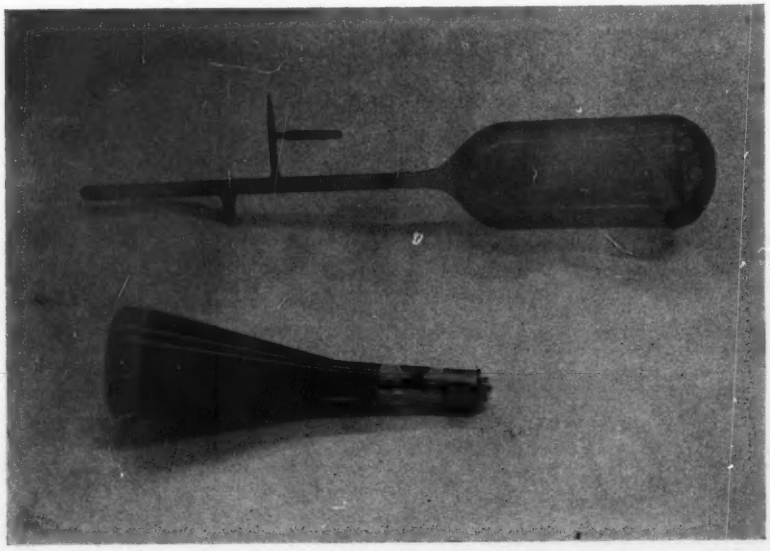
Prior thereto, the only cathode tubes available were of small size, and only qualitative measurements had been attempted. Professor Ryan secured one of the early Braun tubes and, foreseeing many possibilities of the device, ordered from abroad a larger tube specially built with a 5″ screen, and directed the construction of suitable mounting and auxiliary equipment for using the device for quantitative as well as qualitative measurements. A description of the apparatus was given by Asst. Prof. George S. Macomber, and published in the Sibley Journal of Engineering, Volume XVII, No. 7 (April 1903).

The cathode tube was of glass about 30″ long and for about one half its length, ¾″ in diameter, and then expanded to a diameter of 5½″ at the end containing the screen. A sealed-in platinum terminal at the opposite end of the tube formed the cathode and about 12″ along toward the middle of the tube, a glass diaphragm was provided. This allowed a small pencil of rays to pass through and produce a luminous spot where it struck the fluorescent screen. The anode was located in a small branch tube on the side of the ¾″ tube about halfay between the cathode and diaphragm and a second small tube was provided for exhausting and sealing off the tube.

Provision was made for mounting two pairs of coils with their axes at right angles alongside the small tube, a short distance beyond the diaphragm toward the screen whereby the emerging pencil of rays could be deflected. Through one pair of coils was passed a sinewave reference current which caused the spot on the screen to be drawn out into a straight line along one axis; and through the other pair of coils was passed the current whose wave form and other characteristics were to

(*Continued on page* 34)

The original cathode ray tube compared as to size and shape with a modern tube.



THE YEAR'S TOLL

The following is a list of the 1946 graduates of the College of Engineering:

FEBRUARY GRADUATES

BACHELOR OF CIVIL ENGINEERING

Alexander Drogin
Richard H. Jones, Jr.
Herbert S. Meltzer

BS IN CIVIL ENGINEERING

James Beckett, Jr.
Norman Bernstein
John T. Collinson
Albert C. Cornish *
David K. Fernow
John F. Hallam
Gilbert I. Holmberg
William W. Lawrence
Pierre Godfrey Lundberg
Richard Pietropaoli
Raymond N. Shupe
Stuart H. Snyder
Charles R. White
Alan B. Wright

BACHELOR OF CIVIL ENGINEERING

Hubert R. Askew, Jr.
Edward W. Atherton
Donald C. Beaumariage
Richard N. Bell
Roger Bissinger
Theodore J. Bliss *
Theodore W. Buchter
Raymond L. Hunicke
Horace R. Johnson *
Paul C. Murray
William H. Mutschler
William G. Papsco, Jr.
Jacob S. Samkoff
Peter D. Schwarzz
Charles L. Seeger, III
Lawrence W. Simmons
Ellsworth D. Snyder
Alan D. Sutherland

BS IN ELECTRICAL ENGINEERING

Donald Monroe Demarest
Roy S. Griffin
Henry Harper
Robert Heider
Warren G. Herzog
Robert B. Kaemmerer
Thomas F. Madden
Elmer F. Schaible
Lloyd S. Slaughter, Jr.
Gordon R. Spencer
James W. Toner
Howard M. Warner
Paul F. Weaver
William J. Weigle *
David H. Wilson

BACHELOR OF ELECTRICAL ENGINEERING

Galip Mehmet Arkilic
Howard M. Brown
Richard C. Jensen
Anthony S. Rugare

BS IN ELECTRICAL ENGINEERING

Mac C. Adams
Irwin Alterson
Robert E. Berggren
Owen J. Black, Jr.
Robert H. Bosworth
Alexander Brede, III
Wilson Breiel
Robert F. Carter
George W. Cullen, Jr.
Warren B. Dean
Leslie J. Dolhof
Walter W. Eberhardt
John D. Edwards
John W. Feitner
Warren G. Heer
Emmett W. Hines, Jr.
John D. Holmes, Jr.
Francis K. Iverson
Richard W. Jordan
Franklyn W. Meyer
David L. Moore
Mansour Naghdi
Robert J. Nist, Jr.
Frank D. Price
George A. Reisch
Frank E. Rom
John M. Schultz
Varick D. Schwartz, Jr.
William C. Stewart
Edward A. Thimons
Bruce R. Thomas
Richard J. Wroblewski
Frederic L. Yarrington, Jr.

BS IN ADMINISTRATIVE EINGINEERING (IN M.E.)

Robert G. Carroll
Hays Clark
Richard Dyner

BACHELOR OF CHEMICAL ENGINEERING

Harry H. Almond, Jr.
(Miss) Inez M. Leeds

BS IN CHEMICAL ENGINEERING

Philip Gisser

JUNE GRADUATES

CIVIL ENGINEER

Robert M. Reindollar

BACHELOR OF CIVIL ENGINEERING

Stanley R. Czark
Adam P. Friederich
George L. Fuller
George E. Gates
John P. Gnaedinger
John R. Gritzan
Edward J. Kendrick
Robert L. McMurtrie
Brendan P. O'Hara
Harvey Simpson
Malcolm L. Steinberg
Alfred J. Wood

BS IN CIVIL ENGINEERING

Thomas A. Baldwin, Jr.
Carl Chow
John P. Craven *
Nicholas B. Eddy
Oscar M. Fuller
William J. Gladstone
Robert L. Hetner
Robert M. Hubbard
William A. Miller
Alfred M. Roos
Peter J. Verna

BACHELOR OF ELECTRICAL ENGINEERING

Robert W. Johnston
Benjamin Nichols
Edward J. Raser
Wayne C. Roy
John J. Sweeney
Thomas E. Talpey *
William H. Wilder

BS IN ELECTRICAL ENGINEERING

Calvin R. Carver
Alfred B. Levine

(Continued on page 46)

* With distinction

PROMINENT

Bill

William R. Davies, EE

"Step right up, gamblers. Place your bets and watch those cubes trickle down the board and come up with your number."

You might remember William R. Davies' professional chant for the Delta Club booth at the Spring Day Carnival last May. That was his first try at it; but when the profits were counted, it was decided that he wasn't running the concession for amusement only. It might be said, though, that he has had all the broad background that go into making a good side show barker or, for that matter, a good engineer.

Born in Ohio, he moved to "Bawl-Timer" and attended high school at Baltimore City College. After graduating in June 1940, he was hired by a trust company. Apparently things became too warm there, because he joined the Navy in September 1940. Bill saw combat duty on a "can" in the Atlantic, Caribbean and Pacific. The Caribbean must have liked him best; because he often "wishes to hell" he knew what happened to Guanita down in the Zone or Mame in Trinidad. Obviously enjoying to talk, Bill nonetheless limits his accounts of battle experience to tales of forays with the S.P.'s, M.P.'s, civilian police, "Limey" sailors and, of course, women.

In the fall of 1943, Bill was hit in the back with shrapnel during action in the Pacific. He was hospitalized a few months and in March, 1944 arrived here at Cornell to study Electrical Engineering under V-12 rules. After his discharge on points last October, Bill was readmitted to the school in November to finish his college years as a civilian.

When asked by curious ME's why he's taking EE, Bill answers that he wants to know something useful when he leaves here. In private, though, he admits that he became interested in electrical equipment in the Navy where he held the rate of fire controlman, first class—which isn't what it sounds like, but involves the direction and firing of guns, torpedoes, depth charges, etc. — mostly electrical systems.

Bill has really made a niche for himself here at Cornell. He played varsity football for two seasons, but fouled his knee up so badly that he was forced to direct his ambitions along the quieter things of life. He is president of Eta Kappa Nu, national electrical engineering honor

(*Continued on page 42*)

Charles R. Cox, ME

"Cut that racket out!" is a phrase Charles Cox often heard from his father when he and his high school orcestra were practicing at his home. Says Charles, "I seem to remember as orchestra members we always thought we had a very good group, but I believe an audience never agreed with us. We started playing for dances given in churches and ended up playing for all the dances in the high school. Not much, but we did have fun. But the orchestra broke up when the individual members drifted off to the various colleges."

Charles Roberts Cox was born on June 22, 1925 in Pittsburgh, Pa. After going to a regular high school for two years, he finished the next two years at Shady Side Academy, a prep school near Pittsburgh. He remembers the high school days as being a lot of fun with a maximum of enjoyment and a minimum of work. But it seems Shady Side saw to it that some studying was done. In his senior year he was captain of the basketball team, and he participated in such other sports as track, baseball and soccer. Charles had various jobs during the summer months, but the one he had in a brickyard will stick longest in his memory because it involved the most work.

Charles entered Cornell in July 1943 at the same time as the V-12 ers. From the very start he didn't care much for Ithaca hills, but he was kept busy enough studying to forget about them. Eight terms seemed like one heck of a long time back in '43, but now that it is about over, it just seemed to whiz by. That first summer Chuck went out for soccer and has been with the team ever since, earning his letter each time. He also went out a bit for basketball. After taking ME mechanics in the Spring of 1944, a rest was in order so Charles spent the summer working on a construction job. The next summer he joined Lambda Chi Alpha fraternity.

In his last term here Charles Cox was president of Atmos, honorary society in mechanical engineering. He was also a member of Quill and Dagger, a member of the Judiciary Committee of the Interfraternity Council, and worked on the orientation program for incoming freshmen. And for the future, Charles is interested in construction work and air conditioning.

Charles

ENGINEERS

John S. Christenson, ChemE

John S. Christenson, or Chris as he is called, was born June 9, 1924 in Kansas City, Missouri. Three-quarters Norweigian and one-quarter English, he claims relation with John and Priscilla Alden through one branch of the family. As a young child, Chris lived extensively in many Southwest U. S. cities, staying in El Paso, Texas long enough to acquire a short-lived mania for watching railroad trains which drove his collective relatives crazy. Since 1932 his home has been in Detroit.

There isn't anything in his family's history which points obviously to Chris' selection of his future vacation. His father is an accountant, and his grandparents were a Great Lake Captain and a contractor. Hence why did he take Chemical Engineering? Chris doesn't know, but says "if I had it to do over again, would take the same thing." That statement coming from a ChemE certainly awed us a bit.

During his freshman year at Cornell in 1942, Chris joined Delta Chi Fraternity. He served as secretary for the Chapter before it became inactive because of the war. In the reorganization in 1945 he served as treasurer and president.

Chris has been active in Olin Hall doings. He was a member of the Chemical Engineering Student Council during 1945 and 1946. He was elected to Al Djebar, the chemistry society, in 1945. In 1945 and 1946 he helped with the reorganization of the interfraternity council.

His first job in industry was with the United States Rubber Company. During 1944-1945 he worked in their Testing Laboratory in Detroit, gained useful experience and impressions of scientific and industrial methods. This last summer, Chris "reigned over 3 dogs and a collection of tropical fish while having a vacation in the Arts school obtaining my remaining elective credits."

The main part of a ChemE's fifth and last year in Olin is spent on senior research. The special project which Chris is working on is "settling rates of ferric hydroxide." His plant design project is to design an alcohol plant which, needless to say, has him quite interested.

Chris graduates in February of 1947. After that he hopes to work for an oil company in a production job back in Texas "where they don't know what rain or snow are." His next choice would be to work on the development of the gas turbine and jet propulsion. Chris says of the ChemE school, "It not only turns out excellent theoretically trained men, but through the close personal guidance of the faculty turns out men equipped to handle any future problems."

Chris

Robert A. Olmsted, CE

"Where will I be on my twenty-first birthday? Oh, I'll probably celebrate by riding on the Tokyo subway." Such was the prediction of Bob Olmsted, C.E. sophomore, back in 1942 at a time when Jap armies were on the march and Uncle Sam was freely mailing out "Greetings" to prospective GI's. Little did he know at the time how near to the truth this prophecy would be, for Bob was riding the subways in Osaka, Japan's second city last September, more than a month before number twenty-one.

Robert A. Olmsted was born in the great metropolis of New York

Bob

in 1924, and has, more or less, lived there ever since. Fascinated by all the new buildings, bridges and tunnels being built in the big town, he decided to study civil engineering. After graduating from DeWitt Clinton High School in 1941, Bob wasn't sure what college he was going to, that is until he saw his name in the New York Times one morning as a Cornell Tuition Scholarship winner. So that September the Black Diamond brought just one more freshman of the class of '45 to Ithaca.

During his Frosh year, Bob explored the countryside around Ithaca with the Outing Club, joined the Railroad Club, the ASCE and went out for the CORNELL ENGINEER. That summer he worked as a draftsman in a New York engineering office.

That fall Bob wasn't willing to undergo the terrors of another ride on the Lehigh, so he, along with a fellow classmate, left New York by bicycle. Four and a half days later the two of them pulled into Ithaca after three hundred miles of pedalling, just in time to see the Lafayette game.

The biggest event in Bob's second year was the joining of the Enlisted Reserve Corps; for two weeks after the end of the Spring term little Robert found himself dressed in khaki and getting fifty dollars a month. After spending the summer in Texas taking infantry basic, the Army sent him to Princeton University to study civil engineering in ASTP. Following this Bob was

(*Continued on page* 42)

NEWS OF THE COLLEGE

New M.E. Director

WILLIAM JULIAN KING, authority on combustion and gas turbines with Battelle Memorial Institute has been named director of the Sibley School of Mechnical Engineering and professor of mechanical engineering at Cornell. He succeeds W. N. Barnard, professor of mechanical engineering emeritus, who retired June 30, 1946. Most of Professor King's career has been with the General Electric Company, having served with that organization from 1926 until 1945 when he went to Battelle Institute in charge of fundamental research in combustion. He received the B.Ch.E. in 1925 and the M.E. in 1933 at Tulane University. A member of ASME and Tau Beta Pi, Professor King holds patents on heating and air conditioning, and is the author of several professional articles.

Education Award

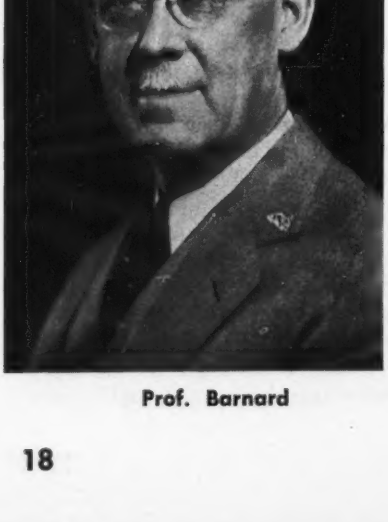
PROFESSOR J. N. GOODIER, head of the Department of Machine Design and the Department of Mechanics at Cornell was awarded the Westinghouse Award for Notable Contributions in Engineering Teaching at the annual meeting of the Society for the Promotion of Engineering Education, held in St. Louis. Professor Goodier is the first recipient of the award which is for $1,000. A committee headed by President H. L. Dodge of Norwich University made the selection after studying the 1945 teaching and administrative performances of engineering faculty members in colleges and universities throughout the U. S.

Dr. Goodier is a graduate of Cambridge University where he received the M.A. and Ph.D. He received the Sc.D. from the University of Michigan, and from 1931 to 1938 was a research fellow of the Ontario Research Foundation. During the war he administered special courses in stress analysis and elastic stability at the Bell Aircraft and Curtiss-Wright airplane divisions in Buffalo, and directed research work on aeronautical projects at Cornell.

At the same meeting. Prof. L. L. Doty, Hydraulic Engineering, gave a talk on "The Place of Hydrology in the C.E. curriculum."

Aeronautical Director

DR. WILLIAM R. SEARS, chief of aerodynamics for Northrop Aircraft, Inc., Hawthorne, California, has been named the first director of Cornell's new Graduate School of Aeronautical Engineering. He was also made professor of aeronautical engineering.



Prof. Barnard

Prof. King

Dr. Sears received the B. Aero E. at the University of Minnesota in 1934. Until 1941 he was on the faculty of the California Institute of Technology, receiving his Ph.D. in 1938. He was a member of the U. S. Naval Technical Mission to Europe, and the Scientific Advisory Board of the Army Air Forces, and is a member of Sigma Xi and Tau Beta Pi.

The Graduate School of Aeronautical Engineering was created by the Cornell Board of Trustees in October, 1945 and was formally opened in September 1946.

Engineering Physics

One of the nation's first schools of engineering physics with a five-year curriculum opened at Cornell University in September, "To train students in a combination of engineering principles, applied physics and mathematics for careers in research and development."

Known as the Department of Engineering Physics, the new division is designed to help meet industry's demand for men with broad training in these fields to engage in the increasingly important work of industrial research and development.

According to Dean S. C. Hollister of the College of Engineering through which the new department is administered, "The Department of Engineering Physics will bridge the area lying between the training in basic science and in fundamental engineering." He pointed out that the traditional curriculum in engineering falls short on the side of basic science, and the physics curriculum falls short on engineering principles.

Operated through the cooperation of several colleges at the University, chiefly Engineering and Arts and Sciences, the new department is staffed by selected members of the engineering and physics faculties. The degree, Bachelor of Engineering Physics, will be awarded upon completion of the five-year curriculum, and graduate work

will be offered through the Graduate School of the University.

Dr. Lloyd P. Smith, who is serving as director of the new department in addition to his post of chairman of the Department of Physics, was originally trained in both engineering and physics, receiving the B.S. degree in electrical engineering at the University of Nevada, and the Ph.D. in physics at Cornell.

He was associated with RCA Laboratories in Princeton, N. J., for five years during the war, the last year as associate research director. He also served six months on the Manhattan Project at Berkeley, Calif. He continues in the capacity of consultant for RCA Laboratories.

According to Dr. Smith, the curriculum of the new department is designed to present the broadest possible training in engineering and physics, and also some training in the liberal arts. Courses are so arranged, he said, that students transferring from other curricula up to the end of the sophomore year will be able to do so with a minimum of difficulty.

He also stated that the curriculum will be an exacting one, and that only students with a high degree of achievement and ability will be admitted.

Students will have wide latitude in selecting specialties within the engineering physics curriculum. such as atomic physics, x-rays and crystal structure, optics, spectroscopy, electronics and ionics, ultra high frequencies, wave propagation, communications, properties of materials, engineering electronics, electronic properties of solids, elasticity and stress analysis, aerodynamics.

New Vice-Presidency

A NEW vice-presidency of Cornell University has been created by the Board of Trustees to be filled by Dean S. C. Hollister of the College of Engineering. Dean Hollister will continue as head of the College of Engineering while assuming new administrative duties. As a vice-president of Cornell, he will be in charge of University development.

Dean of the engineering college since 1937, Dr. Hollister was first appointed to the Cornell staff in 1934 as director of the School of Civil Engineering. Prior to that he was professor of structural engineering at Purdue University. He has served as consultant on the Boulder Dam project. He also served the U. S. Engineer Department as consultant on testing methods and devices in soil mechanics, and the U. S. Maritime Commission as consultant on concrete ship design and construction. He is a member of the Governor's advisory committee on technical industrial development.

Dean S. C. Hollister

Among his achievements at Cornell have been the promotion of the new Graduate School of Aeronautical Engineering, a five-year curriculum in all branches of engineering, integration of the new Cornell Aeronautical Laboratory and the high voltage laboratory into the educational program of the University, and a comprehensive building program for the development of the physical plant of the College of Engineering.

Recent Appointments

Among recent appointments on the Cornell staff is that of Professor Robert F. Chamberlain as assistant dean of the College of Engineering. In addition to his professorship in electrical engineering, he will also continue in charge of the placement office of the College, of scholarships in engineering, and of secondary school relations with the College.

JOSEPH GALLUCHAT TARBOUX, head of the Department of Electrical Engineering, University of Tennessee since 1929, and former Cornell faculty member, has been appointed professor of electrical engineering at Cornell University. Born in Brazil, he was graduated from Clemson College with the degree of B.S. in 1918. He has received three degrees from Cornell: the E.E. in 1923, M.EE. in 1926, and Ph.D. in 1937. Professor Tarboux holds memberships in the honorary societies of Eta Kappa Nu, Phi Kappa Phi, Tau Beta Pi, and Sigma Xi, and is a fellow, American Institute of Electrical Engineers. He has had much practical experience and is the author of several books on electrical power systems.

Faculty Promotions

PROMOTED to the rank of full professor in the College of Engineering are the following members of the faculty:

Paul Howard Black, professor of machine design. He received the M.E. from Rensselaer in 1925, the M.S. from the University of Pittsburgh in 1931. Professor Black served as an instructor at Rensselaer and the University of Illinois before coming to Cornell in 1937.

Stephen Farrell Cleary, professor of engineering drawing. He received the M.E. from Cornell in 1925, and the MME. in 1929 .Professor Cleary is the co-author of a textbook on descriptive geometry and mechanical drawing and author of articles on these subjects.

Romeyn Yatman Thatcher, professor of civil engineering. After receiving the C.E. degree at Cornell in 1909 he served with the New York Central Railroad, the Interstate Commerce Commission, and the Lackawanna Steel Company before returning to the University as an instructor in 1924. He is a faculty advisor of the CORNELL ENGINEER.

True McLean, professor of electrical engineering. A graduate of Cornell with the E.E. degree in 1922 he was with the Bell Telephone Laboratories one year before returning to Cornell as an instructor in 1923. He has served as a consultant for a number of electrical

(Continued on page 32)

Recent Developments In Engineering

Techni-Briefs

X-Ray Photometer

A NEW kind of "seeing" instrument, whose x-ray vision can detect counterfeit coins, spurious diamonds, and certain impurities in many types of solid, liquid, or gaseous materials, has been developed.

Called the X-ray Photometer, the new device is a rapid, accurate analyzer able to indicate in a second or two the concentration of certain chemical elements in the presence of others.

Plus its potential role as a detective, the instrument is expected to find application determining sulphur content of oil, tetraethyl content of gasoline, ash content of coal, heavy metal content of glass, and concentration of fillers and impregnating agents in wood, cloth, and rubber.

The new instrument operates by aiming an x-ray beam through material being tested and then measuring the amount of ray absorbed by the material, according to G-E researchers.

In testing a questionable coin, a genuine coin is first checked for its amount of ray absorption. The doubtful coin is then checked, and if its amount of ray absorption does not match that of the genuine coin, the doubtful coin can be assumed to be counterfeit.

In most other applications, however, the instrument employs aluminum discs of different thicknesses which act as proxy for the known item, against which the unknown item is being checked. In checking a diamond, for example, the stone in question is compared to an aluminum disc, whose thickness corresponds in ray absorption to a genuine diamond.

Because genuine diamonds are almost pure carbon, very little radiation would be absorbed, whereas fake diamonds of glass, particularly if they have a lead content, would absorb a much larger amount of radiation, according to the researchers.

Estimating the amount of ash in a piece of coal without actually burning the coal may seem like a crystal gazing job, but the x-ray photometer performs the task with science rather than mysticism.

First, the component chemicals of coal that result in ash are checked for the amount of x-ray absorption, and the aluminum disc which absorbs a like amount of radiation is selected. Then, any sample of coal is matched against the disc. Since the amount of x-ray absorption of the sample is in ratio to its ash-producing elements, the amount of ash in the coal can be calculated.

In like manner, gasoline can be checked for its tetraethyl lead content, which provides "pep," glass can be checked for lead content, which in this instance imparts brilliance, and oil can be checked for sulphur content, which is apt to cause corrosion of metal parts contacted.

The x-ray photometer measures ray absorption by directing an x-ray beam at a fluorescent screen. The strength of the ray, after it has passed through material under test is transposed by the fluorescent screen into visible light, intensity of which then is measured by photoelectric equipment. Final reading is given on a dial.

X-ray photometer-machine that takes no wooden nickels.
—Courtesy G. E.

Loran

SUCCESSFUL completion of the first crossing of the Pacific by a merchant ship using loran — the modern electronic method of long-range navigation—has been announced.

The trip was made by the Waterman liner, John B. Waterman, employing a compact RCA loran receiver with which the navigator was able to ascertain the position of the vessel with high preceision—day or night and regardless of weather conditions.

The loran receiver was installed aboard the John B. Waterman at Chickasaw, Ala., before the start of the vessel's maiden voyage, which included passage through the Panama Canal and across the Pacific over the Great Circle Route to Shanghai.

Arriving in New York after completing a 20,000-mile journey in 127 days, Second Mate William Fleck, who operated the loran equipment aboard the ship, reported to Radiomarine that the apparatus performed with uncanny accuracy. Comparative fixes, he said, were made by celestial navagation on the voyage from San Pedro. Calif., to Shanghai. They revealed the modern system to be functioning perfectly.

Good weather prevailed during the entire length of the first loran-guided crossing of the Pacific, Mr. Fleck reported. But he said there would have been no doubt as to the ability of the loran equipment to have kept the vessel on her course had heavy fog or storms come along. One of the chief advantages of the system is that it makes it possible for navigators to take their ship on

the most direct course, spending less time at sea and thereby saving fuel. In distress, a vessel could include the most accurate position in its call for assistance.

The equipment aboard the John B. Waterman was reported to have worked best in the evening and during the early morning hours when the range increased from 750 to 1,400 miles. It was explained that this is customary since atmospheric conditions for radio transmission are better during those periods.

Electronic Collector

A NEW electronic collecting device which uses static electricity to remove oil mist, smoke, and dust from heavily laden air in manufacturing plants has been developed.

Just as static electricity causes bits of paper to cling to a comb, an electrostatic field set up in the device electrifies foreign particles in the air and causes them to adhere to collector plates, while the "cleansed" air passes on. Approximately 90 per cent of foreign matter in the air is removed through this process, it is said.

This G.E collector concerns itself more with oil mist and smoke than with dust. The collector is designed primarily for use in manufacturing plants, where high speed cutting and grinding operations cause heavy concentrations of oil mist and smoke in the immediate atmosphere.

After "inhaling" such heavily laden air, the collector first filters out the heaviest and largest foreign particles. Then the air moves through an ionizing unit, which electrifies each tiny particle of oil, smoke, and dust with a positive charge. Negatively charged collector plates, being of opposite polarity, immediately attract the particles. While the particles adhere to the plates, the "cleansed" air passes on and out the collector ready for use again.

Meantime, the oil mist and other foreign matter remains on the plates until the charge dissipates, then drops down into an oil reservoir. Indicating how much mist air can carry, as much as five gallons of oil has been collected in a reservoir in a single day, it is reported. Collected oil, after being passed through a filter, can be used again an indefinite number of times, it is said.

Although there is an economy in oil thus recaptured, chief benefit of the collector is the elimination of unsightly and unhygienic operating conditions. Uncollected oil mist and smoke eventually would collect of its own accord on machinery, tools, and other equipment in the plant.

Cleaning all incoming air in the house, and placed ahead of heating, cooling and air conditioning devices in the home's air conditioning center, is a Precipitron, an electronic air cleaning device developed by Westinghouse, which removes as much as 90 per cent of all dirt, dust and other foreign particles in incoming air at a rate of 1,500 cubic feet of air per minute.

Enclosed in a cabinet little larger than the familiar electric refrigerator, the Precipitron is a simple device which includes no moving parts. Air coming into the Precipitron passes numerous strands of fine tungsten wire—the same metal used in filaments of incandescent lamps.

New Street Light

THE gap between mathematics and street lighting may seem a broad one, but to the Cleveland Lighting Division, the two are practically inseparable. In fact, when they set out recently to develop a new street light, they came up with a new reflector that was shaped according to a purely mathematical analysis.

The basis for the design was as much information as they could gather on street-surface conditions all over the nation. They determined how light was reflected from such different kinds of pavements as macadam, concrete, or red brick. They learned how reflectivity varied between flat, dry surfaces and glistening, wet surfaces. Then they combined this information with other data to draw a curve of ideal light distribution, from which they derived mathematically the exact reflector shape necessary to provide it.

The new design turned out to be something entirely different in street lights. The reflector is a long, solid oval, shaped somewhat like a half watermelon sliced lengthwise. The enclosing glass lens below the lamp, also designed mathematically, controls the light that comes directly from the reflector and spreads it out evenly from every elevation. Even the light that would ordinarily be wasted at the edge, where glass and reflector join, is recovered and directed onto the street. The result is that over 71 per cent of the light produced by the lamp emerges from the unit, a sizable increase in the efficiency of street luminaries.

New Insecticide

TESTS in the United States show that the English-developed new insecticide sometimes referred to as benzene hexachloride is not a replacement of DDT and has at present serious shortcomings. This is the insecticide disclosed in a congressional hearing recently on the 1947 Agricultural Department supply bill. It was said to be seven times more effective against flies than DDT.

Hexa-chloro-cyclohexane, the correct chemical name of the insecticide, has a most disagreeable, pungent odor, and does not possess the long-lasting toxicity in the field that makes DDT so outstanding. Experimental reports point to limited use of the insecticide for controlling household, storage and livestock insects because of the odor. It is more toxic to flies and cockroaches than DDT. In agriculture, tests show it is superior to DDT against such major pests as aphids, grasshoppers, wire worms, and several cotton insects including the boll weevil. Under normal weather conditions where these pests occur in this country, the insecticide is not effective for more than two to four days. It is also more likely to damage foliage than DDT, especially tender truck crops. Through research, a more effective and less odorous form of hexa-chloro-cyclohexane will be produced.

ALUMNI NEWS

CHIN-PAO CHIU, MCE '37, is professor in charge of the civil engineering department and dean of students at the National University of Yunnan, Kunming, China.

BENJAMIN F. BARDO, ME '13, superintendent of the Providence division of the New Haven Railroad since April 1939 has become superintendent of the New Haven division. He joined the railroad in 1914 as a member of the electrical transmission department, serving subsequently as inspector of power plants, superintendent of electric transmission and assistant superintendent of the Boston and Hartford divisions. For a time he was on the Rhode Island Manpower Commission.

BOB GERHARD, ChemE '44, has been promoted to group leader in the Light Oils Technical Service Division of the Wood River Plant of the Standard Oil Company of Indiana. He is also cost representative and patent advisor for this division.

FRANK BOWEN, ChemE '33, is in charge of the Chemical Engineering Division of the Toledo Refinery of the Sun Oil Co. Bowen designed the butadiene and aviation gasoline plants at Toledo.

P. T. CLARK, BChemE '34, is manager of the Fall Brook Plant of the Corning Glass Works at Corning. He was recently transferred to the Fall Brook Plant from the Charleroi Plant of the same company.

J. J. KRAUKLIS, Ph.D. '44, is the author of the article on manifolding service lines, appearing in the July issue of Chemical and Metallurgical Engineering, that has been awarded the prize of fifty dollars for the best short article submitted for publication in the "Plant Notebook" for that month. He is with Standard Oil of Indiana.

ROY THOMPSON, BChemE '43, is with the Army-Navy group that conducted the first atomic bomb test at Bikini. He was in the B-29 that made the practice dry run over Bikini, and assembled the bomb that was dropped in the test.

JULIAN C. SMITH, ChemE '42, is returning this fall as Assistant Professor of Chemical Engineering. Since graduation he has been with the Industrial Engineering Department of the DuPont Company and has been in responsible charge of the development of processes and design of equipment for that company.

CHARLES R. JONES, JR., EE '43, and CHARLES H. FLETCHER, JR., '45, have joined Westinghouse Electric Corporation as members of its graduate student course. Mr. Jones served six months in the Signal Corps and twenty-seven months in the Air Corps as a radar maintenance officer. He received his training at Harvard and MIT. Mr. Fletcher belonged to Kappa Alpha and was circulation manager of the "Widow."

JOHN W. SHEFFER, ME '07, has been appointed General Improvement Engineer for the American Car and Foundry Company. In this capacity he will have direct charge of the Improvement Division with headquarters in New York.

He began his association with ACF in 1908 at the Berwick plant as Electrical Engineer and later served in the capacities of Assistant to the General Superintendent and Plant Engineer. During these 17 years he was engaged also with welding developments of all description, and was in part responsible for important advances made in welding at ACF plants. In 1926 Mr. Scheffer transferred to the New York office and since that time has been occupied with improvement and development problems in the Company's plants. Mr. Sheffer holds membership in the American Welding Society, Iron and Steel Engineers, and Cornell Society of Engineers.

AMICUS MOST is the managing director of the newly formed Parkway Foundry and Machine Corporation in Brooklyn, N. Y. The company will produce non-ferrous castings by sand, permanent mold and centrifugal methods in a new plant occupying more than 120,000 square feet. Mr. Most has devoted most of his life to the foundry business. He has been associated with the General Bronze Corporation of Long Island City, and the original Parkway Foundry Company.

LOU MEAD, B.Chem.E. '43, is out of the army and is now with Carbide and Carbon Chemical Corp. at Oak Ridge, Tenn.

DON BRUCE, B.Chem.E. '44 is with the Standard Oil Co., of Indiana. He is in charge of analyses of all incoming crudes. He reports that Carlton Baker, B.Chem.E. '44 who is with the same company, is to be one of the two men in direct charge of the big new catalytic cracking plant at Whiting.

(*Continued on page* 42)

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You see . . . thousands of builders, craftsmen and chemists building a new wonder world of wood.

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machines and equipment that help to expand the mighty wood industry—that enrich your life by bringing the new world of wood closer to you!

* * *

How big is Allis-Chalmers in this picture? Not only America's No. 1 builder of sawmill machinery—but important source of barkers, chip screens, kilns and allied equipment for pulp and paper mills—one of the nation's leading producers of processing machinery for the chemical industries!

What reason for this bigness? A unique reputation for product engineering and integrity—vast industrial experience—craftsmanship of the highest order—*a reputation known and respected in every industrial field!*

Today, Allis-Chalmers supplies major products for virtually every basic industry . . . has a hand in making almost every machine-made commodity you can name.

Allis-Chalmers is a good name to know!

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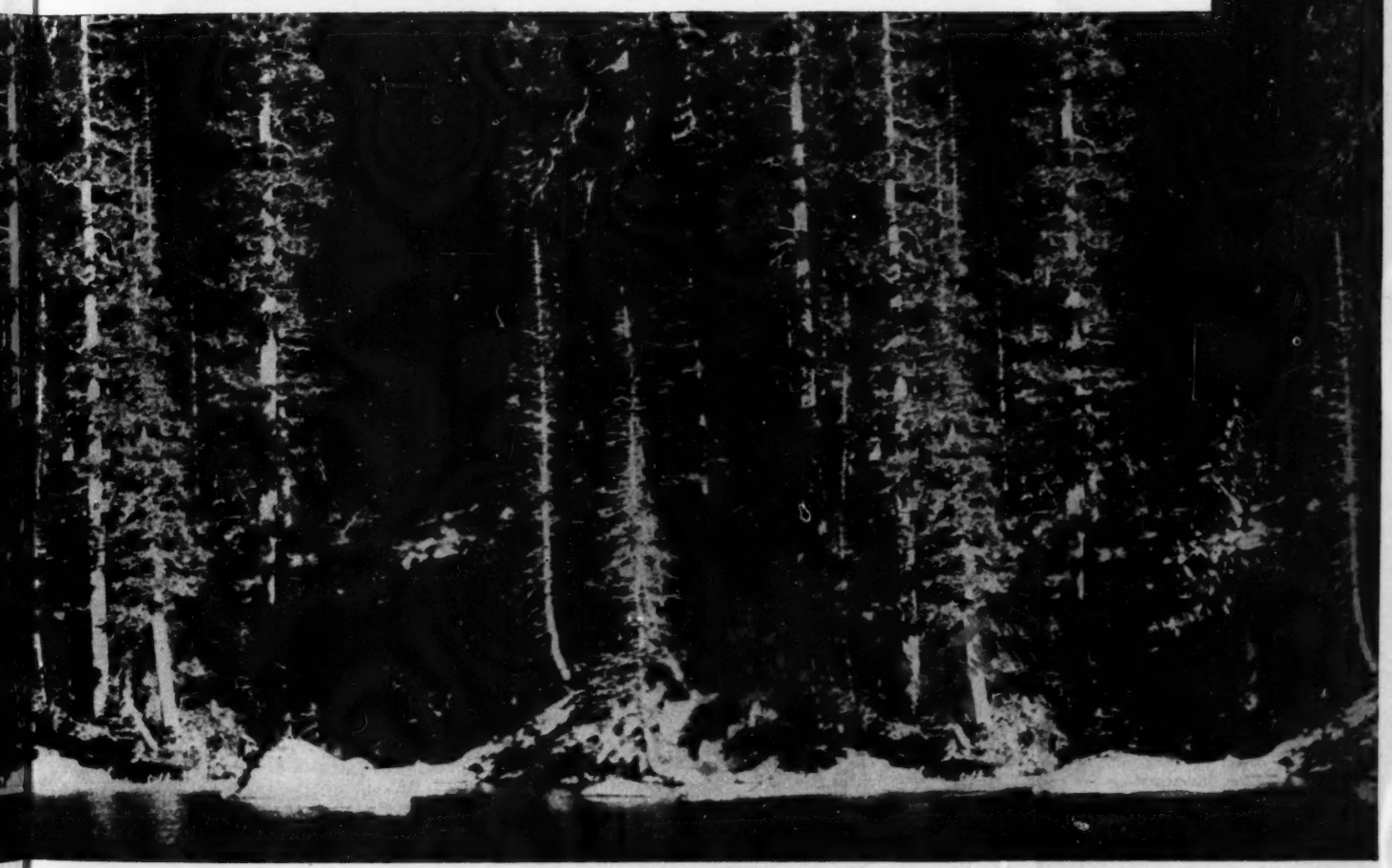

TUNE IN THE BOSTON SYMPHONY over the American Broadcasting Company, Saturdays, 9:30 P. M. EST

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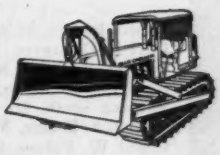

Allis-Chalmers builds tractors like this for the logging industry—mills for making flour—machines for mining and processing ores—pumps for moving almost any fluid—compressors and blowers—welders—speed changers—literally 1600 important industrial products. Call the Allis-Chalmers office in your city.

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"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

Dear Fellow Cornellians:

I am happy of the honor and privilege to chat with you through this medium. I have not been to Ithaca as much as I should have liked to in recent years so, feeling that it behooved me to get first-hand information, I spent three days there recently. They paid big dividends, not only in giving me time to talk leisurely with Dean Hollister but also in affording me the opportunity to chat with other professors, faculty members and alumni. I realized how deep are the memories of the chimes, the sunsets and the coming and going of the every-day life. The deeped I got into the atmosphere of Cornell the more I appreciated how privileged is one who can spend four or more years there.

My work has taken me to many states in the Union and to a number of foreign countries, and I have had opportunity to visit many universities in all these places. I know of no university that has the same rare combination of equipment, staff and inspiring surroundings as Cornell.

One of the things I went into at Cornell was the matter of the procedure being gone through which decides just who among the thousands of applicants will be the favored ones to be granted admission. I can assure you that all concerned are carrying out a definite sequence of investigations to make sure that those best qualified are given a place.

I have had several people contact me to see whether some direct word or appeal wouldn't help get their son or friend in. After investigating the careful manner in which each application is studied and the fairness with which all facts are considered, I am advising my friends that drag and pull are not taken into account.

As is customary at this time, we are printing for your information the list of the coming year's Executive Committee, which is the governing body of your Society.

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Bernard A. Savage, M.E. '25
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Mechanical Engineering
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Chemical Engineering
Henry R. Gundlach, B.Chem. '11
L. Van Lee, Ch.E. '42

We all need your help this year in enabling the Society to establish that closer relationship between the college, alumni and the graduates for which it was established. I will have more to say about this in my next Message.

—ROBERT B. LEA

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This is the organization that continues to give America the finest telephone service in the world:

A group of Associated Companies provides telephone service in their respective territories.

The Long Lines Department of A. T. & T. handles Long Distance and Overseas service.

The Bell Telephone Laboratories and Western Electric Company are responsible for scientific research and the manufacture of equipment.

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Here the man of engineering skill—electrical, mechanical, civil, industrial and chemical—has wide opportunity to help meet the challenging changes of our time. For telephone engineering calls for a broad engineering viewpoint as well as specialization.

Basic technical knowledge, an appreciation of economic factors and the ability to cooperate are some of the things that count in Bell System engineering. As the System expands, opportunities for interesting life-work become constantly more varied.

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Which you will need for your courses are in stock at

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TRIANGLE BOOK CO-OP

EVAN J. MORRIS, *Prop.*

Electrical Engineering

(*Continued from page* 9)

tank shown with its control boards has six anodes completely controlled by grids.

The mainstem laboratory courses in power circuits and rotating machinery are given on the second floor of Rand Hall. Laboratory instruction for mechanical, civil and chemical engineers is being moved from the basement of Franklin Hall to the "Old Heating Plant", where the facilities developed for giving the electrical instruction in the Navy Diesel Engineering Training Program will be used.

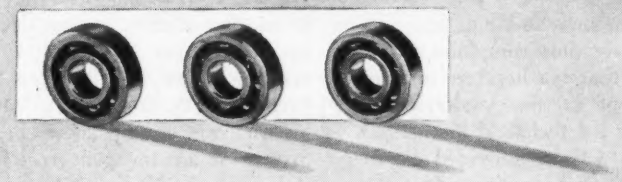
This laboratory, which has recently been acquired from the Navy, forms a very useful addition to the School. It is outstanding in its adaptation to the requirements of typical undergraduate instruction. It was planned to maintain the utmost flexibility and to avoid interference between groups of students working simultaneously at various stages of the course. While the laboratory contains no startling innovations, it has proven by successful use that it is eminently capable of giving to students, in proper balance, the elements of demonstration, operation and incentive to analysis. A picture of this laboratory, shown in Figure 4, indicates the type of switchboard layout and machine installation that is planned for the new building.

The High Voltage Laboratory of the School, located beyond the Campus proper on Mitchell Street, provides equipment for testing up to 750,000 volts at 60 cycles and up to 3,000,000 volts on impulse. Since Professor Zimmerman's article (Cornell Engineer, Vol. 11, No. 7, April 1946), apparatus has been purchased for making impulse tests of equipment under load.

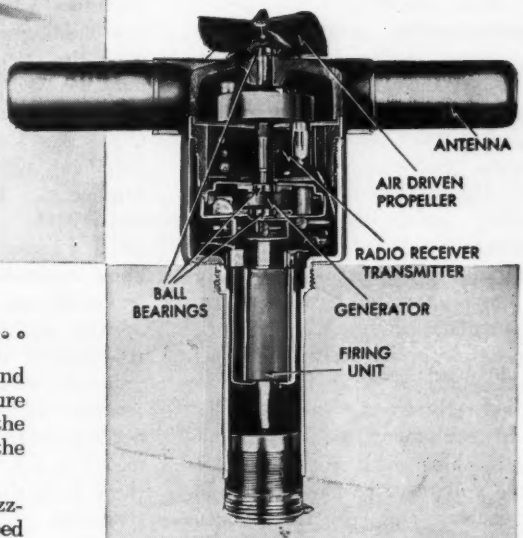
(*Continued on page* 30)

Fig. 4. Layout in the "Old Heating Plant".

Three little ball bearings



...and how they flew at 100,000 RPM!



Generator-Powered Bomb Fuze

Sponsored by O.S.R.D. and the U. S. Army with Central Laboratories at the NATIONAL BUREAU OF STANDARDS.
Below: V.T. Fuzed Rocket in action

STORY OF THE VT (Variable Time) FUZE...

America's VT or Proximity Fuze is a wonder of the war second only to the atom bomb. In the nose of a projectile, its miniature sending and receiving set sends radio waves ahead. When the target is neared, the waves bounce back and — before the projectile can miss—they explode it!

This "Seeing Eye" feature was 97% effective against V1 buzz-bombs...helped clear the Pacific beaches for invasion...helped turn the tide in the Battle of the Bulge... raked the mainland of Japan... and was deadly against Jap Kamikaze planes.

On land, at sea and in the air, it gave us a super-accuracy of fire that saved countless American lives and materially shortened the war.

...AND THE VT (Very Tough) BALL BEARINGS THAT HELPED MAKE IT POSSIBLE!

But to make such miracles possible, bearings on the fuze's rotor and impeller shaft must withstand *100,000 revolutions per minute!* Could *any* bearing "take" such speeds and centrifugal force?

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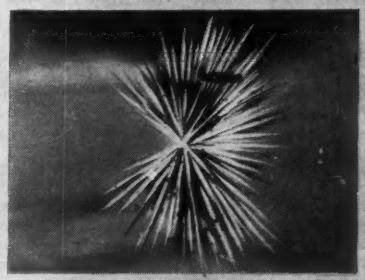
New Departure Ball Bearings are uniquely fit to handle great speeds—as well as heavy loads and requirements of super-rigidity...

... but there is more to a ball bearing than steel and engineering principles. New Departure, world's greatest ball bearing maker, is also famed for *solving problems!* 3423

SENSITIVITY PATTERN



BURST PATTERN

Pictures courtesy of National Bureau of Standards

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NEW DEPARTURE
BALL BEARINGS

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Electrical Engineering

(*Continued from page 28*)

Money is now available for the architect's fees for the new building so that the plans on which the faculty has been working will soon be in blueprint form. This building will be on the new engineering campus east of Olin Hall of Chemical Engineering. The new building will have adequate laboratory facilities for basic electrical measurement, standardization, rotating machinery, power systems, servomechanisms, electrical aircraft equipment, basic electronics, communication, high-frequency and radiation, industrial electronics, vacuum tube construction, accoustics, and illumination. Besides these laboratories which will be used mainly for undergraduate instruction, there will be individual research rooms each to accommodate a small group working on a special research project. Both precision shop facilities for skilled technicians to work on electrical equipment requiring accurate machine work, such as microwave apparatus and measuring instruments, and general purpose shop facilities for the research worker who may construct his own experimental equipment, will be provided. The present system in which lectures are illustrated with demonstration equipment that has proved so effective will be carried over to the new building.

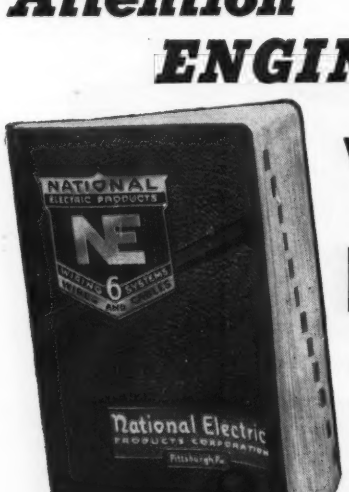
It is a common complaint among students that teachers are unavailable except in the classroom, and then only for technical discussions. Facilities will be provided in the new building where the student may meet the staff socially. Here ideas may be exchanged freely, and the student may enjoy the benefit of the staff's long experience, sound judgment and mature mind. The teacher can know the pupil—his social background, his chief interests and ambitions. A teacher should know his student so intimately that he could recommend him as a man as well as a scholar. The war has returned to the school an undergraduate who is both eager and serious. In his rehabilitation he needs more than a specialized training. The school must return something more than merely a technical specialist.

The faculty has returned from its first vacation in five years. A rested ambitious faculty, relieved of the drudgery of war and its training programs, is timely for the fifty per cent increase in enrollment.

It has been well said that a school is no better than its faculty. To gaze back over its record, Cornell may be proud. But to stop for a backward glance is only to catch a breath for scaling new heights. Study for advanced degrees is being encouraged among the younger members of the staff. All interested can enter research of the individual's choice. Publication of technical papers and texts is highly approved. Participation in technical societies is a means for exchange of developments and is promoted by the school.

The Electrical Engineering Faculty has spent much time, effort, and careful thought in designing the new curriculum, building the laboratories and planning the new building. The entire program was created by the faculty, and with the faculty lies the responsibility for its successful execution. This is no small venture.

Attention ENGINEERS!



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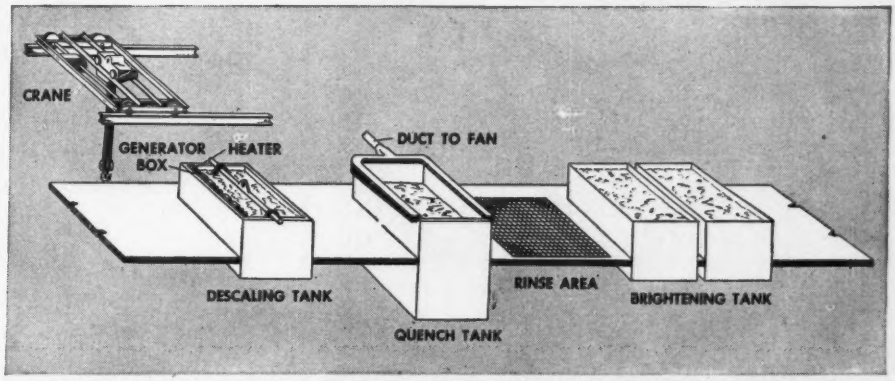
Du Pont Digest

Items of Interest to Students of Chemistry, Engineering, Physics, and Biology

Chemistry Finds Better Way to Descale Steel

One of the most bothersome problems in the metal industry is the removal of scale from the surface of stainless steels and other alloys. Scale is a thin film of metal oxide which forms at high temperatures during fabrication or processing. It is very abrasive to dies and other metal-forming tools, and if not completely removed causes serious flaws in the surface of finished products.



A typical layout showing arrangement of equipment for sodium hydride descaling. The usual treating cycle comprises sodium hydride treatment, water quench, water rinse and acid dip for brightening.

Several years prior to World War II, Du Pont chemists, engineers and metallurgists went to work on the problem of developing a quick and positive descaling process. When success came three years later, a secrecy order prevented its public announcement at that time—the discovery went directly into war work.

Process Development

In developing the process, a group of Du Pont Chemists found that small amounts of sodium hydride, dissolved in molten sodium hydroxide, effectively removed scale without attacking the base metal or embrittling it. However, the problem then arose of finding an efficient and economic means of obtaining the sodium hydride. This was accomplished by developing an ingenious apparatus for forming it directly in the molten sodium hydroxide (700° F.) from metallic sodium and gaseous hydrogen.

Metal chambers, open at the bottom, are placed along the inside of the descaling tank and partly immersed in the bath. Solid sodium is introduced into these chambers, and hydrogen gas bubbled through. The sodium hydride formed is diffused uniformly throughout the molten caustic.

Practical Application

The metal to be descaled is immersed in the bath which contains 1.5 to 2% of sodium hydride. Scale is reduced to the metallic state for the most part in from a few seconds to twenty minutes, depending on the size and type of material.

The hot metal is then quenched in water, and the steam generated actually blasts the reduced scale from the underlying metal. A water rinse and a short dip in dilute acid complete the process and produce a clean bright surface.

This process has been called the most significant development in the cleaning of metal surfaces in decades. It is representative of what men of Du Pont are doing to help American industry to better, quicker, more economical production methods.

• • •

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Du Pont cellulose sponges have many of the attributes of the kind that grow in the sea, plus several additional advantages. For example, quality can be kept uniform; texture and hole-size can be predetermined; they can be cut to handy shapes, and they may be sterilized by boiling.

The complicated 10-day manufacturing process starts when viscose is produced by adding carbon disulphide to alkali cellulose (from wood or cotton), and dissolving the mixture in water and mild alkali. To produce holes, crystals of the desired size are introduced. Heating in a salt solution hardens the viscose and dissolves out the crystals. Washing, centrifuging and oven-drying complete the operation.

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College News

(*Continued from page* 19)

firms and is chief engineer for station WHCU.

Burdette Kibbe Northrop, professor of electrical engineering. He graduated from Cornell in 1918 with the degree M.E. in E.E., and the same year was named an instructor at Cornell. From 1923 to 1929 he was an associate professor at Colgate University, but returned to Cornell as an assistant professor that year.

Thomas William Mackesey, professor of regional planning in the College of Architecture. Professor Mackesey received the B.Arch. in 1932 at the Massachusetts Institute of Technology, and the M. City Planning in 1938. From 1932 to 1937 he was secretary to the planning board of Lynn, Mass., in addition to working on projects for zoning and planning other New England cities. He came to Cornell in 1938, and is secretary of the College of Architecture.

The following were promoted to the rank of associate professor in the College of Engineering:

Henry Baatz Hansteen, electrical engineering; George Winter, civil engineering; Casper Lehman Cottrell, electrical engineering; Bartholomew J. Conta, heat-power engineering; David Dropkin, mechanical engineering; Roger Loren Geer, materials processing; William Emerson Mordoff, engineering drawing; Louis Leslie Otto, mechanical engineering; and Lawrence T. Wright, heat-power engineering.

Promoted to the rank of assistant professors are: Charles R. Otto engineering materials; Walter J. Purcell, engineering materials, and Robert H. Siegfried, engineering drawing.

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Since its foundation in 1921, the student chapter of the American Society of Civil Engineers has been in operation on the Cornell Campus. Membership is open to all students regardless of class or standing within the class.

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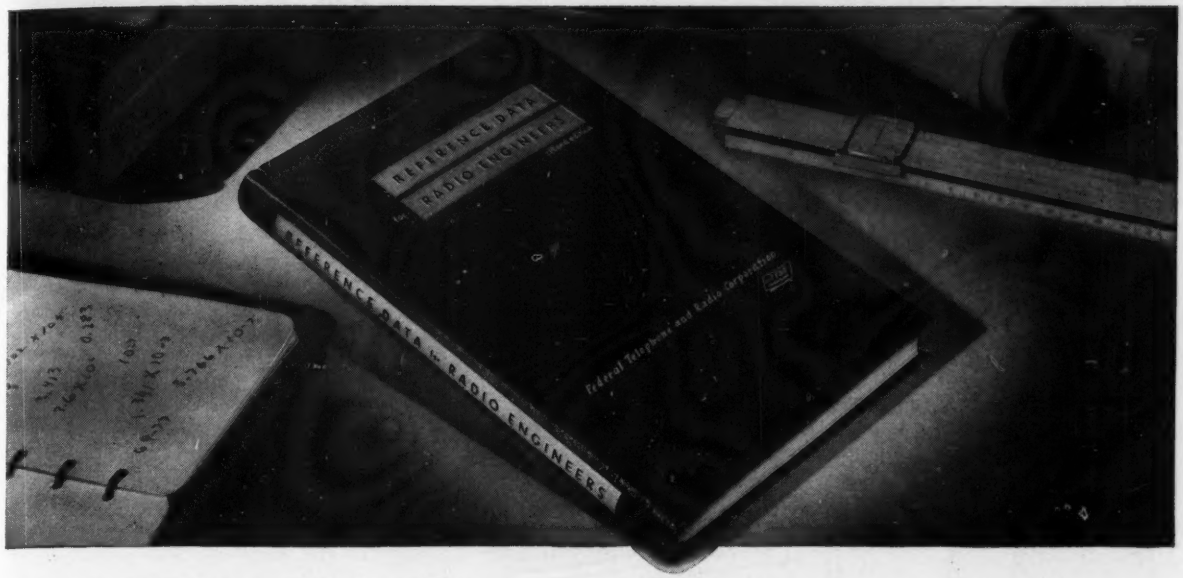

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Commenting on the first edition, Walter J. Seeley, Chairman, Department of Electrical Engineering, Duke University, wrote enthusiastically:

> ***"It is so chock full of useful data that I am urging all students to purchase their own personal copies . . . fills a long-felt need for a convenient compilation of both mathematical and engineering data, and the combination will be appreciated by all who have to work with radio circuits and their concomitant mathematics. That applies especially to teachers and students and I should not be surprised if it becomes a must in many college courses."***

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Cathode Ray

(*Continued from page* 14)

be observed. By this means the spot of light was given a rotary motion and described a closed figure or "card" on the screen.

The tube excitation was by a motor-driven 12-plate Wimshurst machine which was mounted on a stand conveniently nearby, together with auxiliary equipment including inductors and capacitors used to obtain a resonant circuit for supplying the sinewave reference current. The tube was mounted vertically with the screen upward in a case provided with a glass top on which, by aid of an elevated peepsight, tracings could be made of the form of card produced on the fluorescent screen. Arrangements were also made for photographing the screen directly.

Probably the first use ever made of the cathode ray for obtaining definite quantitative results by measurement of wave form, was made in an investigation of losses occurring on high tension transmission lines due to corona or brush discharge. Much of the apparatus for this purpose was constructed by the writer in his capacity as mechanician (1899-1903) and was used in a thesis study presented for his degree in electrical engineering. In this investigation, the conditions of operation of a high tension transmission line were simulated by passing a small wire along the axis of a galvanized iron tube about 14 feet long and 15″ diameter. In order to obtain sufficient deflection of the cathode ray by the minute charging current of this 14 foot transmission line (less than .01 amp.) a pair of coils was built each containing 23,000 turns of .002″ diameter copper wire especially drawn and insulated for this experiment.

The wave form of the charging current to this line was observed when operating at varying potentials which were determined by use of a spark gap voltmeter and checked with instrument readings. At a certain critical voltage (about 20 kv.), ionization occurred and was observed as a "corona" discharge on the small wire at the center of the cylinder, and at this same

(*Continued on page* 36)

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Cathode Ray

(*Continued from page 34*)

voltage a pronounced change in the wave form was also observed on the oscillograph which indicated atmospheric conduction and energy loss in the line above that critical voltage, which loss increased rapidly at increasing potentials.

For determining the amount of these losses, a calibrating or "capacity" circuit was employed using a second conductor external to the tubular transmission line of sufficinetly large diameter so that ionization did not occur at the voltages used. The position of this conductor was adjusted to have the same normal capacity as the "transmission line" circuit and a 4-way switch was provided so that either the "transmission" line or the "capacity" line, as they were called, could be connected to the measuring coils, the other circuit being by-passed.

In the tests, two sets of readings were made at various voltages up to about 60 kilovolts, one set being with the "line" circuit, the other on the calibrating or "capacity" circuit, and the curves were photographed in a darkened room.

The variations in wave form between curves produced by the two sets of readings were accurately measured by an integrator, the sine-wave reference curve—or abscissa—having been previously replotted in rectangular coordinates. By calibration of the deflection produced by a known current through the measuring coil, the scale of ordinates could be determined. Considerable difficulty was experienced with this early cathode ray tube due to sudden variations in the deflection produced by a given current due to conditions not then well understood, which had the effect of changing the scale in the middle of a test. However, as the scale of abscissae and ordinates both varied simultaneously, the values of the ordinates were obtained by direct proportion.

From data obtained from these curves, the charging current and actual amount of power lost on this miniature transmission line was readily determined at various voltages. Formulas were derived for determining losses due to corona and critical voltages were established for transmission line circuits of various dimensions.

The circuits used and results obtained were reported by Professor Ryan in a paper at the 184th meeting of the American Institute of Electrical Engineers at New York, February 26, 1904, entitled "Conductivity of the Atmosphere at High Voltages."

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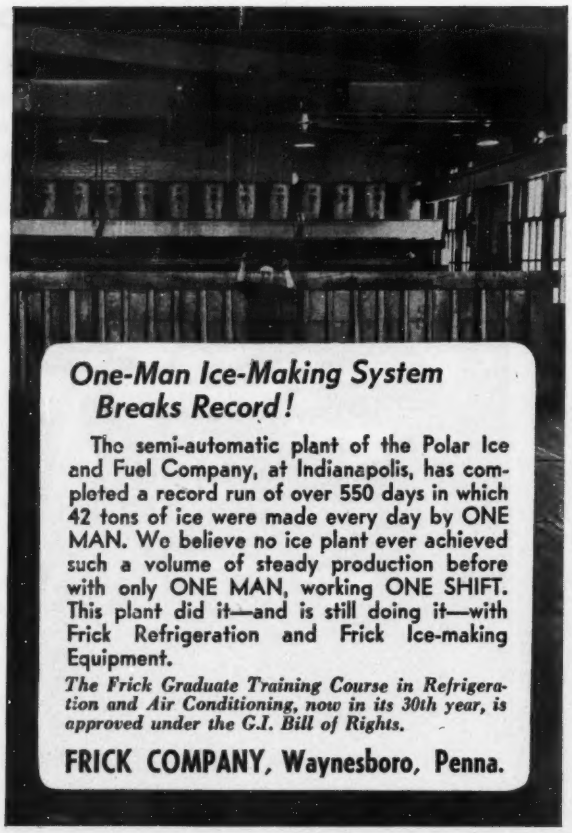
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Engineer & Organized Labor

(*Continued from page* 11)

collective bargaining, free from employer interference, or coercion of any kind. It will be noticed that the Wagner Act makes it mandafor the *Employer* to collectively bargain with labor, but it imposes no requirement that *Labor* shall collectively bargain with the employer. The labor union can make contracts, and break them, when it suits its purpose, without being liable in damages for so doing. They are exempt from taxation in every form, even though they should engage in business for a profit. The labor union is free to "by-pass," and even treat collective bargaining with contempt, in a labor dispute. This novel and recent development in the technique of winning a strike, became manifest, when through refusal to collectively bargain, the Federal government seized private property (strike bound), and executed a contract with the labor union, and, gave the strike bound employer the alternative of accepting the contract as drafted, or submit to continued government operation and control of his property.

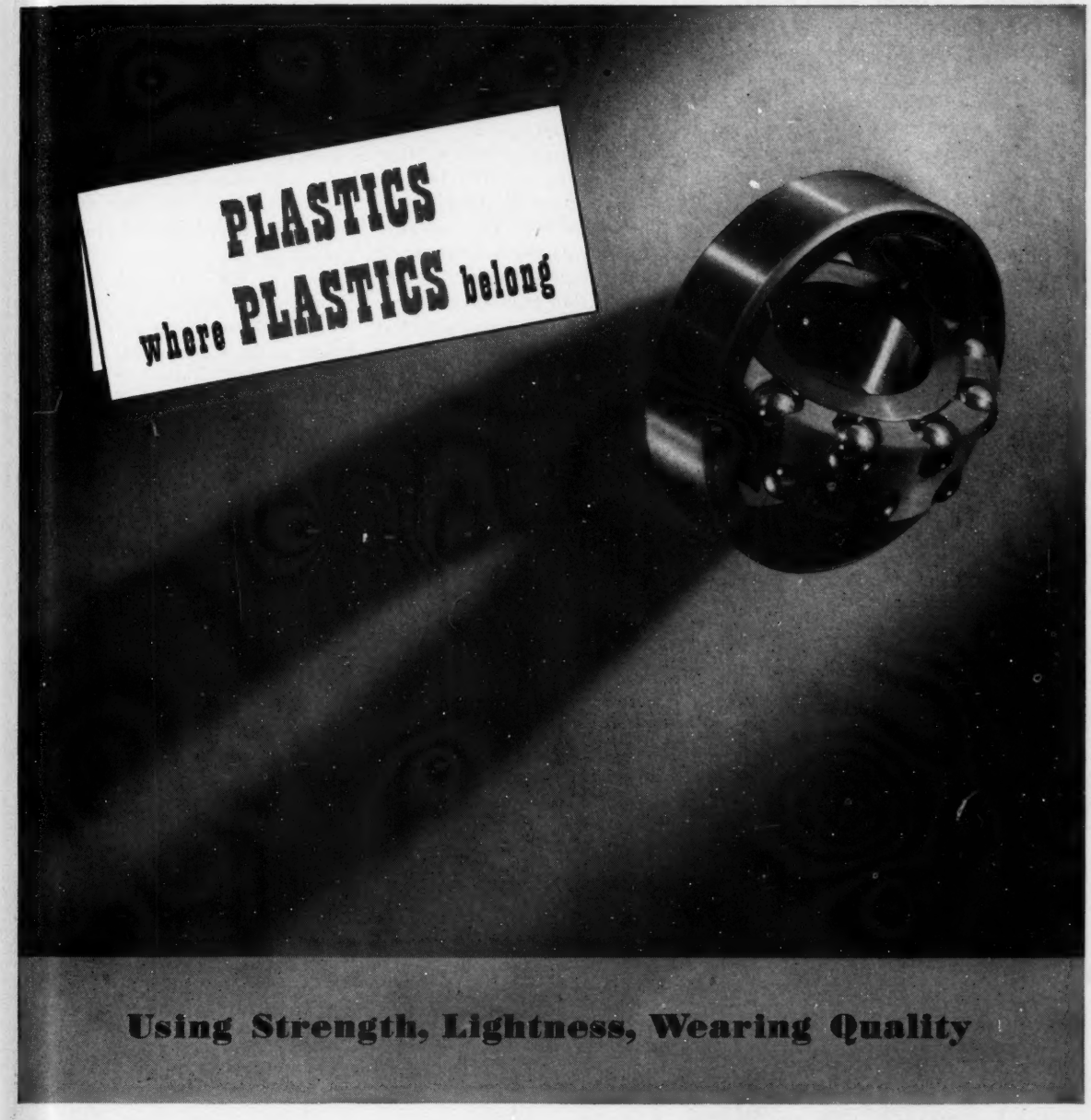
Collective Bargaining

The preceding sections have presented the intrinsic characteristics of the Professional Engineer and Organized Labor, by extreme contrast. The interesting point, is whether collective bargaining applies, in a practical manner, to the profession of engineering. It is apparent that professional engineering and organized labor are incompatable, with respect to their inherent purposes, when considered as having common problems with an employer. Professional engineering has been confirmed into the "learned professions", and has been blessed with the dignity of Statutory law. Labor is toil, by physical strength, requiring limited educational training. Collective bargaining is now a legal phrase, which means a unity of effort to achieve a common purpose, or, a meeting of minds, exerted by a collection of workers, in conference with their employer. It is an established requirement of labor law, mandatory only upon the employer, predicated not upon highly trained professional ability, but, based upon the mass laboring capacity of the worker group, as laborers.

One professional engineer varies in education, experience and technical skill, from another professional engineer. Each is unique, and specially expert in his own professional qualifications. The variety of abilities are so extensive, however, that no two professional engineers are alike. Although the several branches of engineering have many common characteristics, the personal ability of every professional engineer, differs from another.

The justification for the existence of a labor union, and its scope and methods, are repugnant to the ideals and true conceptions of professional engineering. As a learned profession, it is endowed with a high intelligent purpose. It pursues its objectives with the wisdom of integrity, fair dealing and uprightness of intention. Engineering achievements come into being, when professional character is applied to the determination of technical problems.

(*Continued on page* 40)



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SYNTHANE

Engineer & Organized Labor

(*Continued from page* 38)

There are fourteen million dues-paying members in organized labor in the United States. There are about two hundred thousand professional engineers in this country. About twenty thousand engineers belong to engineering organizations. There are three or four hundred thousands of collateral affiliates employed within the scope of engineering, such as draftsmen, rod and transit men, laboratory technicians, and student engineers. If collective bargaining is of interest to the engineering profession, its interest would be confined to the employment relationships of the collateral affiliates. It is very evident, that should the affiliates join with organized labor in order to gain collective bargaining rights, they would be hopelessly outnumbered from the very beginning. The aims and objectives of the minority in organized labor, are disregarded, and often treated with silent contempt. It would be extremely fallacious, and fundamentally unsound for engineering affiliates to effect a joint undertaking with organized labor, for collective bargaining purposes. When a labor union makes a contract with an employer, the minority is bound by an agreement that operates for the benefit of the majority, whether the nature of the minority interest fits into the material substance of the contract, or not. The engineering affiliates would be foreclosed from any further collective bargaining, in their own exclusive interest.

It appears that draftsmen, rod and transit men, laboratory technicians and non-graduate engineers, employed by, or exclusively under the supervision of a professional engineer, is a subordinate affiliate in legalized engineering practice, and is confined to the sphere of operations of the licensed professional engineer. They are not, therefore, within the scope of labor, nor can they be considered as eligible labor material for association with a labor union.

It is very evident that the professional engineer is not involved, nor concerned in any manner, with collective bargaining, within the meaning of labor law, and as used in the field of organized labor.

Engineering affiliated employees, being in greater numbers, may be justified in seeking to gain the benefits of some form of collective bargaining, with the employer, under whom the professional engineer practices, and who is responsible for the supervision of them. The practical and natural course for them to follow, would be to approach the solution of their common grievances, through the channels of an engineering society, or organization sponsored by professional engineers, for the purposes of collective bargaining. The first duty of the subordinate engineering affiliate is to the professional engineering supervisor, because they are "an arm" of the profession, and employed exclusively in that field.

From this discussion it appears that the Professional Engineers are so completely organized and established by law, that they are in the most natural positions to furnish the vehicle for collective bargaining, for their subordinate and affiliated co-workers.

Okonite's general catalog on wires and cables contains information on conductors and coverings, materials and fabrications, and a selector chart. Engineering students may obtain a free copy of this booklet by writing for Bulletin OK-1011. The Okonite Company, Passaic, New Jersey.

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Tutoring in university courses that is effective because directed to individual needs.

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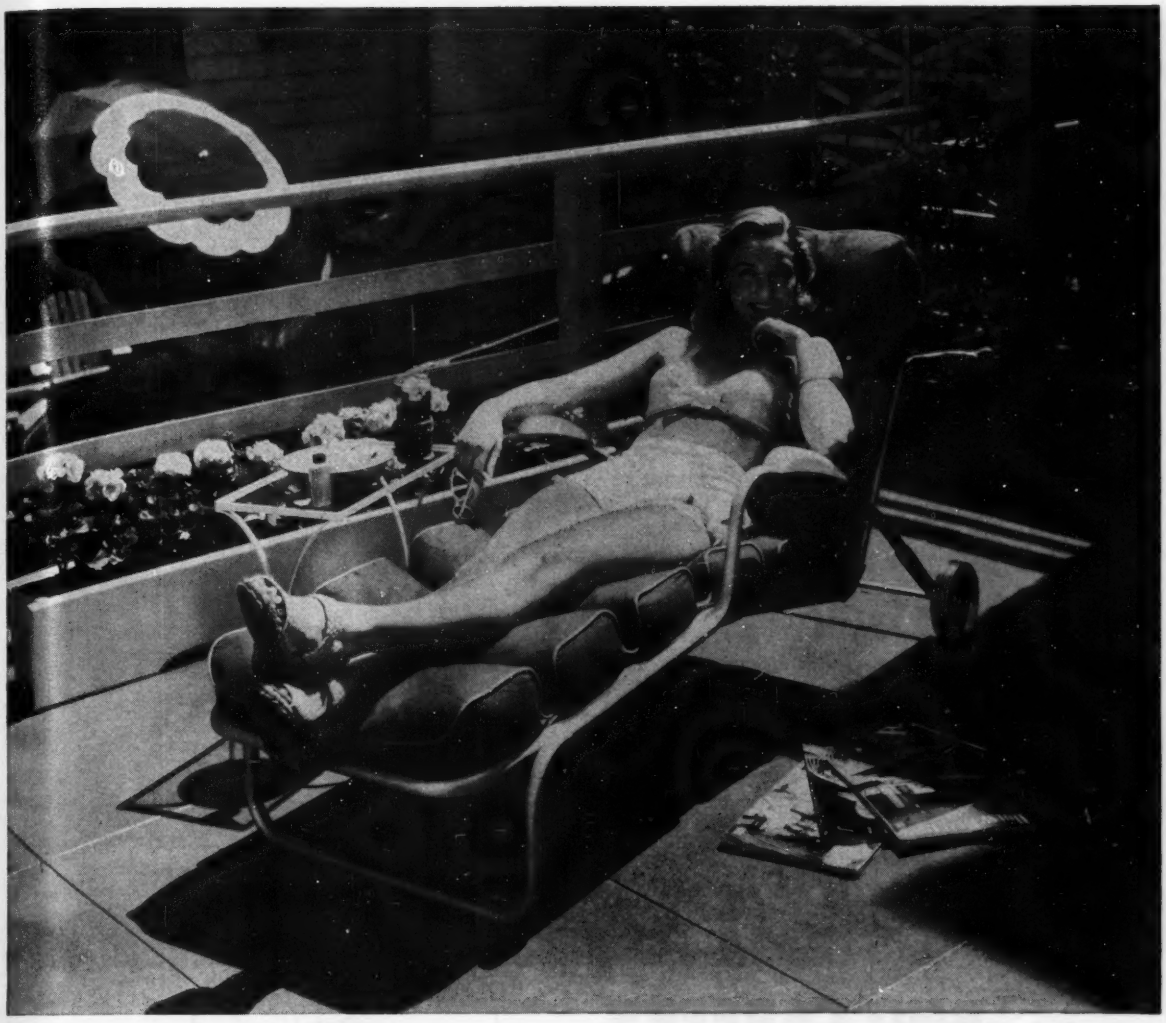
MAXWELL T. KENDALL '36, *Headmaster*



Sun Bath on the Roof

A NICE FLAT roof is a good place for a sun bath.

But when the sunlight is replaced by rain or snow, a roof gets to be a pretty wet and disagreeable place—and sometimes a source of worry and expense to the owner of the roof.

For prolonged contact with water will make many roofing materials deteriorate. Just as sudden changes in atmospheric conditions can cause cracks to develop in the surfaces of some types of roofs.

Koppers offers builders a Coal Tar Pitch Roof that licks both of these common roofing problems. Koppers roofing is able to "heal itself" if cracks do appear in it. And Koppers roofing can resist prolonged contact with water without deterioration. (In fact, you can have a "water cooled" Koppers roof if you want to—several inches of water covering your flat top areas to help cool the rooms below).

The successful application of Koppers chemical and engineering skills to the solution of these roofing problems is typical of the outstanding results obtained by Koppers experts in many other fields.

In the pressure-treatment of timber, the design and construction of coke and chemical plants, the making of variable-pitch propellers, piston rings, chemicals from coal, and many other things, Koppers has achieved a leadership which furnishes convincing evidence that Koppers is indeed the industry that serves all industry.

Why not consult us about the possibility of assisting you in *your* business? Koppers Company, Inc., Pittsburgh 19, Pennsylvania.

The industry that serves all industry

KOPPERS

Robert A. Olmsted

(*Continued from page* 17)

put into the combat engineers and became a T/4 in a water purification section. His engineer outfit took him across the Pacific to the Philippines and then up to Japan last September; and to complete the round trip Bob came home "the long way around" via the Panama Canal. The big day was March 4, 1946. On March 6 Bob was up at Cornell registering for the spring semester.

In that last full term Bob rejoined the staff of the CORNELL ENGINEER, and also extended his literary efforts by editing the ASCE's student chapter publication, the Lincoln Log. He finished his last few hours in the summer session and is just waiting for that sheepskin, his BCE degree. For the future? He'd probably like to rebuild a city or two. Anyway, says Bob, "I plan to give part of my first million to Cornell to build an escalator up the Library slope."

William R. Davies

(*Continued from page* 16)

society; chairman of the student branch of the AIEE; vice-president of the Delta Club; and a member of the Football Club.

For all of this, Bill is a quiet spoken, unassuming fellow, always one of the gang. Although he isn't the fastest "chugger" in the Delta Club, he is one of the more persistant quaffers and values the merits of good beer over good marks any day. Watching him play poker with a black cigar jutting from the side of his mouth, one wonders if he isn't missing his calling—of course, he can always be a salesman.

Bill has a more serious side, though, usually known as a wife. He met "Spud" in February 1945 and married her just one year later. Right now his immediate ambition is to get an apartment so he can bring her up here. Long range plans, however, call for the usual "vine covered cottage" on the main drag of Baltimore, and the not so usual "about ten kids"—and he means it, Spud.

Alumni News

(*Continued from page* 22)

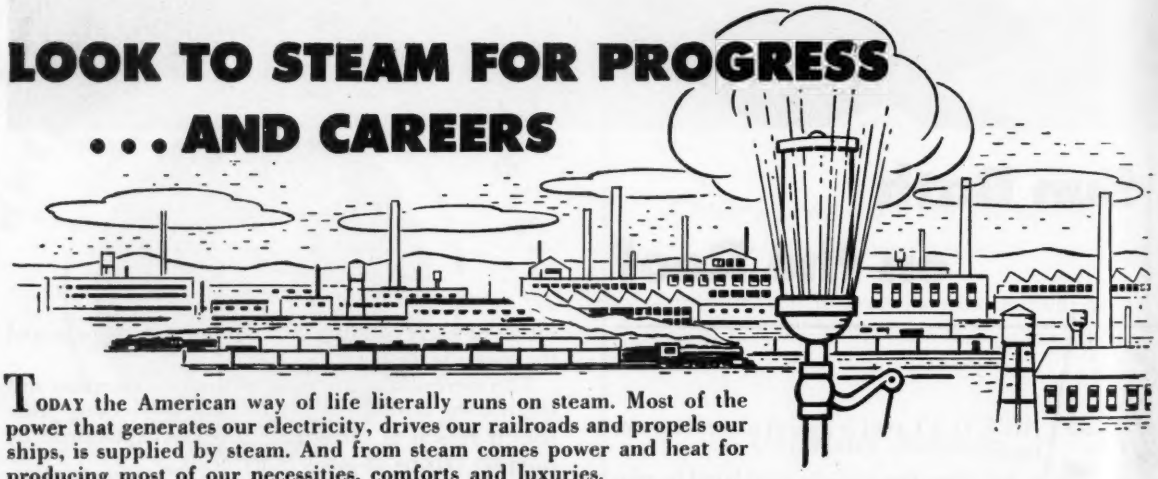
R. Z. VREELAND, Chem.E. '39, is out of the army and is with the New Jersey Zinc Co., in Technical Service Department. He is doing technical servcie work on the use of zinc compounds in paints, plastics, paper, cosmetics, floor coverings, fire retardents, luminescent pigments, etc.

Stephen N. Bear ME '31 is with the Lockheed Aircraft Corporation, Burbank, Calif., as manager of their industrial engineering department.

William J. Hudson M.E. '31 is out of the Navy and is back with the Pure Oil Company at their Winnetka, Ill. plant as a research engineer.

John H. Locke Jr. AEME '42 is out of the Army and is with General Steel Casting Corp., Eddystone, Pa.

LOOK TO STEAM FOR PROGRESS ... AND CAREERS



TODAY the American way of life literally runs on steam. Most of the power that generates our electricity, drives our railroads and propels our ships, is supplied by steam. And from steam comes power and heat for producing most of our necessities, comforts and luxuries.

As synonymous as Steam is with Progress, so B&W is with Steam. For over 60 years, B&W has been designing and building steam generating equipment for industries and public utilities in this country and abroad, and for American naval and merchant fleets that circle the globe. It has maintained leadership in its field through constant development and research and through the production of equipment that sets high standards for quality.

This policy of continued pioneering opens many career opportunities to graduating technical students; careers in diversified, expanding fields of manufacturing, engineering, research, sales, and other activities. B&W will be glad to send you the booklet "Your Career" presenting the story of the Babcock & Wilcox Company in terms of your future.

BABCOCK & WILCOX

THE BABCOCK AND WILCOX CO.
85 LIBERTY STREET
NEW YORK 6, N. Y.

G-334

MAYBE YOU NEED A PIANO LESSON

When you look inside a piano you see a harp-shaped metal plate on which the strings are strung. Even in a spinet it ordinarily weighs well over 100 pounds.

"Too heavy!" thought Winter & Company, who make pianos. (If you've ever moved a piano, you'll agree.) "Let's have Alcoa make an *aluminum* plate."

So, Winter's piano designers and Alcoa engineers put their combined experiences together to develop an aluminum plate. First, a strong aluminum alloy had to be found because the strings put an 18-ton pull on the plate. A special alloy was produced, *but* . . .

As the strings don't pull in the same direction or with the same force, in time the plate would creep, cause distortion, and the strings get out of tune.

Alcoa engineers found a way to tell exactly where and how great the strains were . . . figured out how to balance the stresses and then stabilize the plate by an Alcoa-developed heat-treating process.

The result: The first successful aluminum piano plate, weighing only 45 pounds instead of 125, with tone quality enhanced.

That piano plate offers this lesson for young engineers to remember when they step from college into industry: Take a look at aluminum—with Alcoa engineers at your side—when you want strength with lightness in anything you are designing. Ideas click when men with imagination plus engineering—"Imagineering" as we like to call it at Alcoa—work with this versatile metal and with the greatest fund of aluminum knowledge in the world—Alcoa's. ALUMINUM COMPANY OF AMERICA, Gulf Building, Pittsburgh 19, Pa.

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LAVA

Manufacturers of Super-Refractories Only

◆

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REFRACTORY CRUCIBLES
HIGH-TEMPERATURE CEMENTS
SPECIAL REFRACTORY BRICK, TILE, SHAPES

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From the Following Materials:—

GRAPHITE SILICON CARBIDE FUSED ALUMINA MULLITE
MAGNESIA ZIRCON

◆

LAVA CRUCIBLE COMPANY of PITTSBURGH
Pittsburgh, Pennsylvania

Propulsion

(*Continued from page* 13)

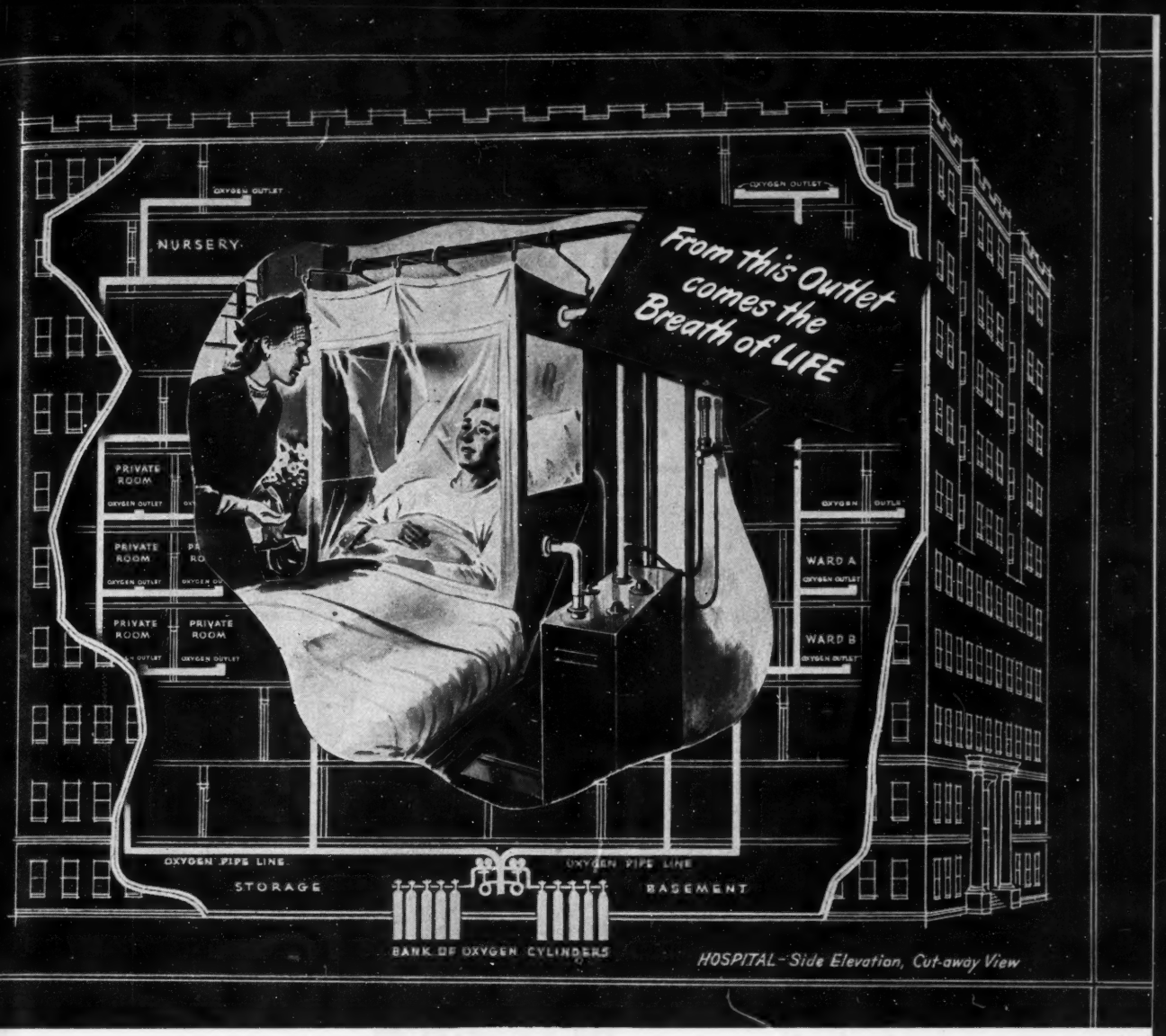
it entered the compressor. As it is confined within the engine, this expansive energy can find only one outlet—through the turbine and thence to the outer air through the exhaust nozzle of the engine. As there is approximately four times as great a volume of air trying to escape from the jet nozzle as originally was packed in front of the compressor, the only way it can get out is to increase its velocity.

Basically the thrust of the engine is a reaction to the force to cause the difference in speed between the air mass as it enters the front of the engine and its speed as it is "jetted" from the rear. Hence a jet propulsion engine is essentially a machine for increasing the velocity of the mass of gas. At low aircraft speeds the efficiency of the jet is poor. It reaches it speak propulsive efficiency only when the forward speed of the airplane matches the rearward speed of the jet; at speeds below that point a certain amount of the kinetic energy in the jet stream is wasted.

Our sense of proportion is dazed in view of some factors involved. These are some figures from a Westinghouse engine. For example, the compressor rams about 50 tons of air—more than a million cubic feet into the combustion chamber every hour. This quantity of air, more than 150 times the engine's own weight, and enough to fill a half mile long building eight feet high and fifty feet wide, is mixed with injected gasoline and ignited. The speed produced by the engine is more than 450 miles per hour faster than the flight of a .22 caliber bullet; therefore the combustor must release prodigious quantities of heat. To raise the temperature of a million cubic feet of air per hour suddenly to 1500°F requires the release of heat hundreds of times as fast as it is released from the average household furnace. One engine liberates enough heat from its fuel in three and a half hours of flight to heat such a house for a whole year.

The high rotational speeds of the jet engine generate enormous kinetic energies; the compressor and its attached disc of turbine blades spinning at full speed pack a 10,000-000 inch-pound—enough to hurl a ten pound weight 15 miles into the sky. The energy in a 75 millimeter artillery shell as it leaves the muzzle of the gun at 1000 miles per hour is only two thirds as much.

What will the future bring? For the present we won't be playing host of our dubious neighbors on Mars, but it is still not to much to call these devices revolutionary. Obvious of course, are the military applications for jet driven projectiles and for high speed aircraft—the German V-1's and V-2's wrought great havoc upon England. Gas turbine jet units will carry you from coast to coast in a matter of a few hours. There are other more remote uses for jet propulsion such as robot rocket mail and express, and the meteorological rocket. No bounds seem to exist to limit man's inventiveness. The often repeated present day code of science "The difficult we do today; the impossible takes a little longer" never seemed to have more meaning than it does now.



HOSPITAL - Side Elevation, Cut-away View

OXYGEN TO BREATHE is the most important thing in the world to one who is ill and unable to get enough for life from the air alone.

The use of oxygen in medical practice has grown rapidly in recent years. Physicians have found it effective in the treatment of certain types of heart disease, shock due to wounds or injuries, following major operations, and for numerous other illnesses.

The need for extra oxygen is so frequent in hospitals that many of them, instead of depending on cylinders of oxygen brought to the bedside, now have convenient oxygen outlets in many rooms and wards. Oxygen is brought directly to the bedside through an unseen "pipeline" from a centrally located "bank" of oxygen cylinders.

Oxygen is a principal product of Units of UNION CARBIDE. It is supplied to hospitals—and in much greater amounts to industry for numerous mass-production operations—largely through The Linde Air Products Company.

Linde Oxygen is now so readily available that no one need ever be without oxygen for any purpose. Oxygen is but one of the many basic and essential products from UCC—materials which, all together, require continuing research and engineering work with over a third of the earth's known elements.

FREE: *Physicians, nurses, teachers, and others who would like more information on the availability of oxygen, and on the various types of oxygen therapy equipment, are invited to write for a copy of the* "OXYGEN THERAPY HANDBOOK." *Ask for Booklet P-10,*

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Products of Divisions and Units include—

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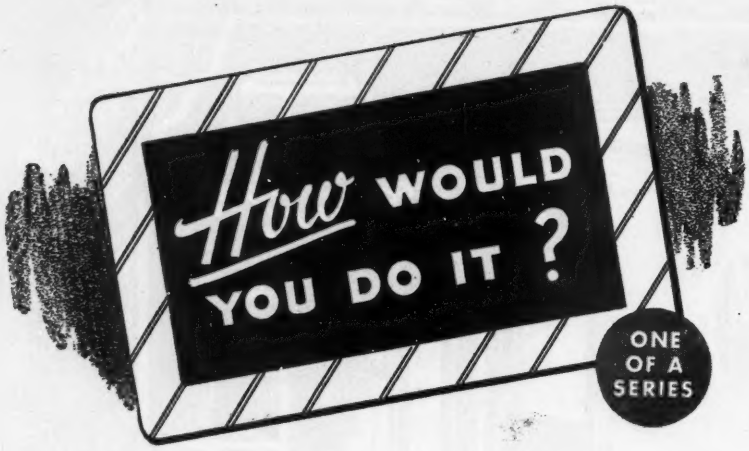


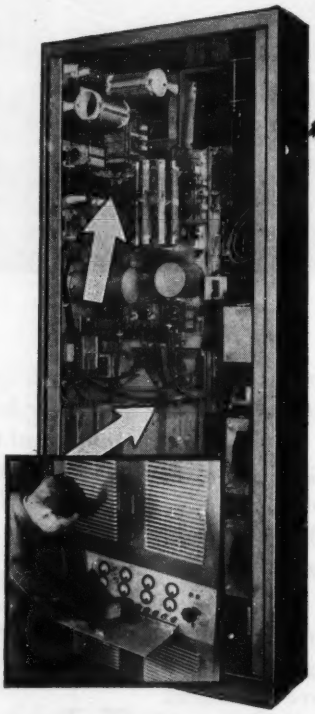
PROBLEM— You're designing a radio broadcast transmitter. The circuit includes condensers and other variable elements which must be adjusted by the operator. You want to place these elements for optimum circuit efficiency and where they will be easy to assemble, wire, and service. At the same time, you want to centralize the control knobs at a point convenient to the operator. How would you do it?

THE SIMPLE ANSWER

Use S.S.White remote control type flexible shafts to couple the variable elements to their control knobs. This leaves you free to place both the elements and the knobs anywhere you want them. And you get control that is as smooth and sensitive as a direct connection because S.S.White remote control flexible shafts are engineered expressly for this kind of service.

★ ★ ★

This is just one of hundreds of remote control and power drive problems to which S.S.White flexible shafts provide a simple answer. That's why every engineer should be familiar with the range and scope of these "Metal Muscles" for mechanical bodies.



Here's how one big radio manufacturer did it.

WRITE FOR BULLETIN 4501

It gives essential facts and engineering data about flexible shafts and their application. A copy is yours for the asking. Write today.

S.S.WHITE INDUSTRIAL DIVISION

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FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
SMALL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED RESISTORS • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING

One of America's AAAA Industrial Enterprises

The Year's Toll

(*Continued from page* 15)

James B. Murtland, Jr.
Robert A. Pelz
Wallace J. Peterson
William C. Shanley, III
George R. Utting
Richard C. Hammond
Alfred L. Koup

RACHELOR OF MECHANICAL ENGINEERING

Lawrence Aquadro
Julio Castro
George H. Ficken
Allen S. Ginsburgh
Milton S. Gross
William F. Hale
Francis G. Paul
Eugene Vos
Maurice J. Zubkoff

BS IN MECHANICAL ENGINEERING

James H. Breckenridge
Harry N. Cotter, Jr.
Alfred E. Czerkas
Theron W. Davidson
Ralph W. Detra
George W. Dexter, V
George A. Fearn, Jr.
Ali J. Fontanella
Carl Edward Glasow
Albert F. Goetze, Jr.
Wilbur H. Haupt
Randall W. Johnson
John C. Leinbach
Solomon Marder
Daniel W. Milburn
Samuel W. Miller, Jr.
Albert O. Schmitt
Emil H. Schoch
Sholom M. Shefferman
Raymond H. Spencer
Paul A. Strauss
Arthur R. Tobias
Paul C. Warner
Gerhard Westphal

BS IN ADMINISTRATIVE ENGINEERING (IN M.E.)

Thomas C. Baumgartner
Robert C. Cowen
Richard P. Kuhn, Jr.
Leonard W. Lewis
Sawyer Thompson, Jr.
Arnold B. Tofias
Emmett Wallace

BACHELOR OF CHEMICAL ENGINEERING

Robert H. Olson

BS IN CHEMICAL ENGINEERING

Walter J. Bray

Many of the above were in the Navy and Marine College Training Programs. The list of men who graduated at the end of the summer session is not yet available.

Working in a Dow physical research laboratory, this young man is operating a machine to test plastic materials.

Plastics—a growing field for the young technician

Interest in the use of plastics grows apace. Products in great variety for the revived consumer's market show their influence —their special utilitarian value—their ready adaptability to ideas in design—their distinctive beauty.

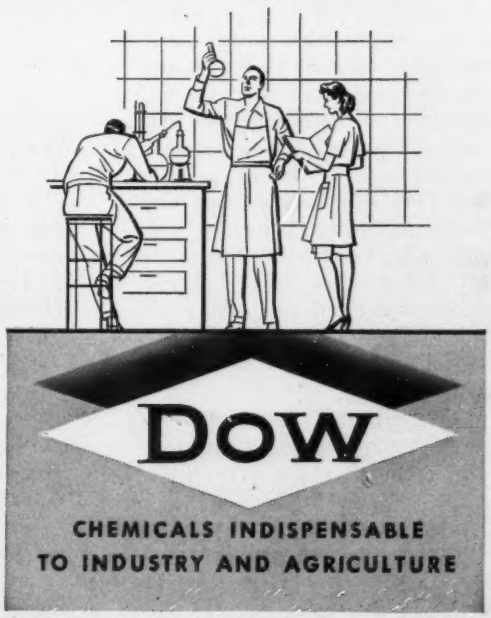
Plastic materials are custom made in the laboratory for modern living. Dow chemists have developed many new plastics among which is Styron, a material that rose to a leading place during the war years. It is a remarkable combination of brilliant beauty and properties of a strictly utilitarian nature. Today, Styron is in demand for products that range from toys and costume jewelry to batteries and automobile parts. Many top-rate refrigerator makers use it in ice compartment doors, shelves and other parts.

Other Dow plastics are: Saran for colorful fabrics that can be cleaned with a damp cloth, non-rusting window screen or corrosion-resistant pipe and tubing; Saran Film and Ethocel Sheeting for better packaging; and Ethocel for durable molded products.

Development, testing and production of these plastic materials are carried on by technical men with special training. It is a great and growing field for young men who can turn their college training in this direction.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit
Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle



STRESS and STRAIN...

Last night I held a little hand,
So dainty and so sweet.
I thought my heart would surely break,
So wildly did it beat.
No other hand in all the world,
Can greater solace bring,
Than the sweet hand I held last night—
Four aces and a king.

* * *

Brown: "Was it crowded in the Belmont last night?

Ihlen: "Not under my table."

* * *

Customer: "Your dog seems very fond of watching you cut hair."

Barber: "It ain't that; sometimes I snip off a bit of a customer's ear."

* * *

Doctor: "How's the patient this morning?"

Nurse: "I think he's regaining consciousness. This morning he tried to blow the foam off his medicine."

* * *

Doc Strong: "You can't sleep in my class."

Freshman: "I know it. I've been trying for the last half-hour."

* * *

Slowly she opened the large door in front of her. There was a prayer on her lips, for this was her only remaining chance. Once through the door she raised her eyes and then came to an abrupt stop. Directly in front of her stood a rough-looking man dressed in a white cloak. The cloak was covered with blood and in his hand the man held a huge knife. For a moment all was silent, then the beautiful maiden said pleadingly, "Have you no heart,"

"No!" the white-robed monster snapped out.

"Then give me a pound of liver," she said, stepping up to the counter.

* * *

M.E. Student: "Professor, is water-works spelled as all one word, or is there a hydrant in the middle?"

An astronomy student was going through the observatory for the first time. As he came in, a professor was at the telescope making an observation. Just then a star fell. The student rushed up to the professor.

"Gosh," he shouted in admiration, "that was a swell shot, sir. Why, you hardly took time to aim at it."

* * *

A Frosh came to class the other day with a very black tongue. We questioned him and this was his reply: "I dropped a bottle of whiskey on a freshly-tarred road."

* * *

Then there's the electrical engineer's daughter who had no resistance, infinite capacity, and was easily induced.

* * *

Chem.E.: "Does your new girl know much about automobiles? "

M.E.: "Heavens no! She asked me if I cooled the engine by stripping the gears."

* * *

The twin was named Encore, because he wasn't on the original program.

* * *

He: "You're a dear, sweet girl, Anna."

She: "But my name is Sue."

He: "You're a dear, sweet girl, anna love you with all my heart."

* * *

Frosh: "Ginger Ale."

Waiter: "Pale."

Frosh: "No, just a bottle."

* * *

Mrs. Henpeck (at a movie): "Is your seat comfortable?"

Mr. Henpeck: "Yes, my love."

"Have you a good view of the screen?"

"Perfect, dear."

"Are you bothered by the conversation of the people on the other side of me?"

"No, darling."

"Then change seats with me."

* * *

She never took Mechanics but she knew a lot about resisting moments.

First Hobo (surveying stream of pleasure seekers)—"I hate holidays."

Second Hobo—"Yes, makes yer feel common when nobody ain't workin'."

* * *

"Dad, what is a counter irritant?"

"A woman who shops and shops and doesn't buy a thing, my son."

* * *

A drunk was watching a revolving door and saw a man walk in. As the door swung around a pretty girl stepped out.

"Darned good trick," he muttered, "but I still don't shee how that guy changed hish clothes so fast."

* * *

"Did you miss your train sir?"

"No, I didn't like its looks, so I chased it out of the station."

* * *

Then there was the Chem. Engineer who died from drinking shellac. The boys all said he had a fine finish.

* * *

Mrs. Jones was spending a day in bed with a severe cough, and her husband was working in the back yard, hammering nails into some boards. Presently his neighbor came over.

"How's the wife?" he said.

"Not very well." Said Jones.

"Is that her coughin'?"

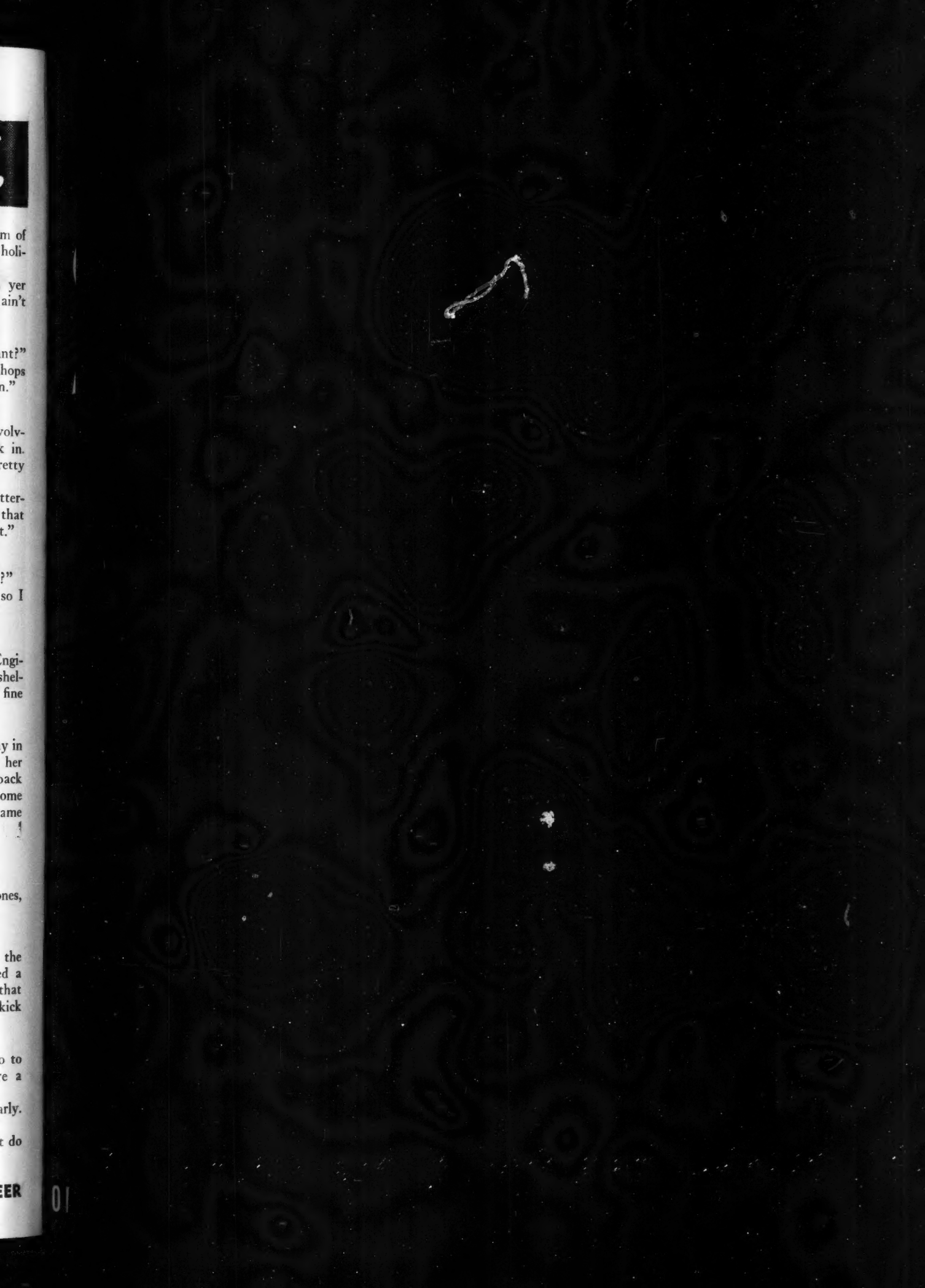
"No, you fathead," replied Jones, "it's a hen house."

* * *

Then there's the one about the veterinarian who tried to breed a mule and a cow. The doc said that he wanted a milk drink with a kick to it.

* * *

Willie: "Say Pop, did you go to Sunday School when you were a boy?"

Father: "Yes son, regularly. Never missed a Sunday."

Willie: "Well, I'll bet it won't do me any good either."